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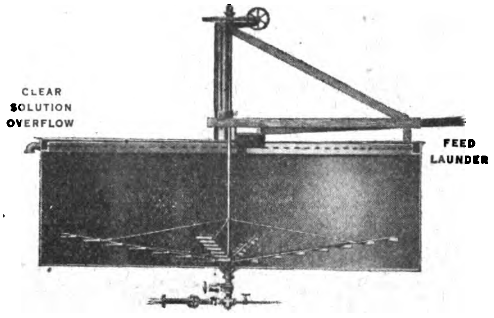

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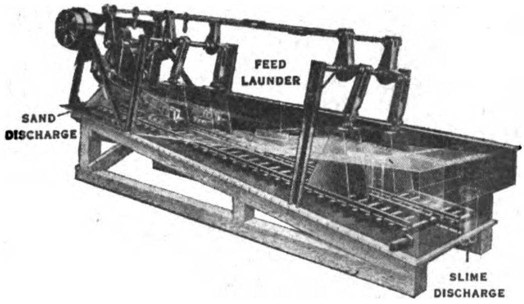

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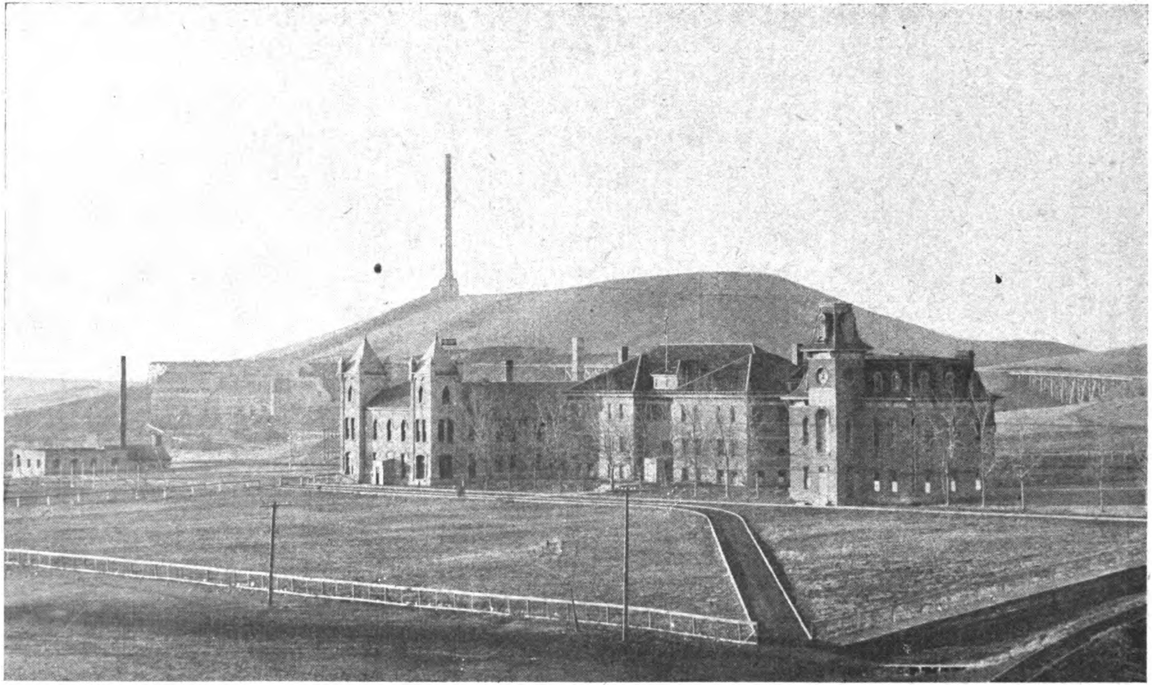

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The
Pahasapa
Quarterly

Vol. I. Rapid City, South Dakota, June, 1912 No. 4.

WATER POWER POSSIBILITIES OF THE BLACK HILLS.

W. R. PUTNAM.

Our present day tendency towards conservation and efficiency has had a marked effect in the increased attention paid to water powers and their development.

Originally only low-head water powers were harnessed and inefficient over-shot wheels were used. The users of these powers gradually came to appreciate the inefficiency of the installations; the great loss of power in this type of wheel; the loss of head, often amounting to more than one-half of the total power, during high water conditions; and also the increased expense of operating several small powers instead of one large power.

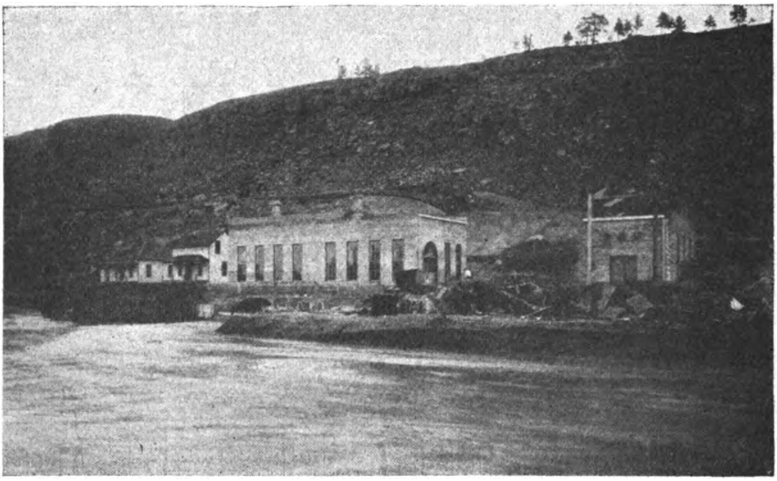
As a result, their attention and that of hydraulic engineers has been turned to high head powers as well as to the better developments of the lower head powers. New designs of wheels have been perfected for the utilization of the force of the water when delivered under high pressure.

These wheels deliver from eighty to ninety per cent of the power in the water to the machinery being driven; water is now being taken out of its channel, and, in many instances, carried for miles, through ditches, flumes or pipes at a slight grade, so that when it is returned to the stream, it has a large fall and thus develops considerable power; in other plants the water is carried in tunnels through the mountains and turned, in some cases, to a different stream, so as to develop power at a more advantageous location.

The rapid strides in the knowledge and use of electricity, together with its peculiar adaptability for the transmission of power have been a great incentive to water power developments.

Formerly a manufacturer must locate his factory at the power site; now the power can be carried many miles, thus allowing the factory to be placed where railroad facilities, raw materials or labor make the most suitable location.

That the availability of water power is having a marked influence in the development of certain sections of this country is shown by the large manufacturing centers of New England, of New York State, of our Central West, as Minneapolis, Duluth, etc.; its influence is peculiarly shown in the shifting of cotton manufacturing from the north to the south, immediately following the building of large hydro-electric plants in our southeastern states.

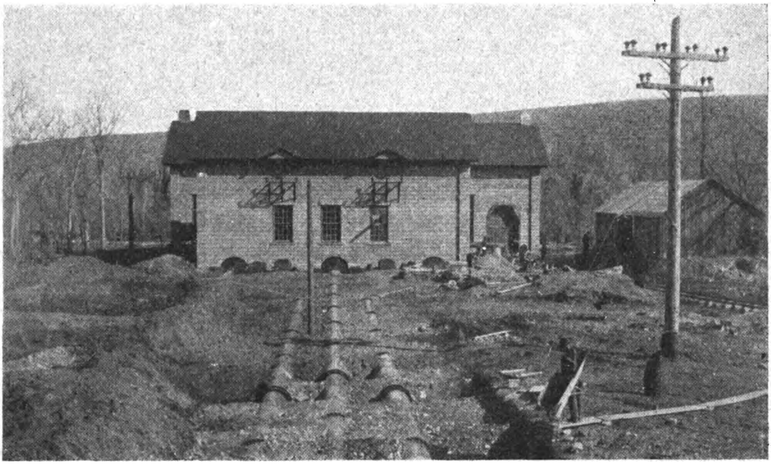


Consolidated Hydro-electric Plant on Redwater Creek.

Possibly, the realization of the rapid rate at which we are depleting our coal supplies, principally for the purpose of generating steam for power purposes; contrasted with the vast amount of "white coal" running to waste in our streams each year, has been the greatest factor in encouraging water power development. This becomes all the more impressive when one realizes that the coal now underground, if undisturbed, will be just as good one hundred or one-thousand years from now as at present, whereas the energy running to waste in the streams is gone and cannot be recovered.

The topography of the Black Hills is especially interesting to the seeker for water-power; with broken table lands and parks at its center, rising from a mile to a mile and a half above sea level, the ground abruptly descends to the plains, surrounding the hills and lying at an average height of thirty-five hundred feet above sea level.

While the average rain fall of the plains is low, that of the mountains is well above normal. The lime rock, underlying the soil on top of the mountains holds back the water from the snow and rains, releasing it throughout the year, so that the flow of the Black Hills streams is fairly constant; and thus, regularity of stream flow being a very important factor in water power developments, the Black Hills powers are enhanced in value. The general direction of all streams of any size in the hills is either to the north or east and they empty into the Belle Fourche or Cheyenne rivers.



Homestake Hydro-electric Plant on Spearfish Creek.

From the time of the earliest mining operations in the hills, water has been used either in sluicing or in driving mining machinery. A great amount of money was spent in diverting works, flumes, etc. These, however, have nearly all been abandoned, due to failure to make the mining operations pay.

Two small powers have been in use at Rapid City for the past twenty-five years and one power at Hot Springs for a long time. The past five years have witnessed the building of four notable hydro-electric power plants.

The Black Hills Traction Company, now owned by the Consolidated Power & Light Company, carry the waters of Red Water over five and a half miles, through ditch, flume, and wood stave pipe and secure fifteen hundred horse-power from the 170-foot fall, where the water is returned to the stream bed. The Homestake Mining Company have two plants; the first one at Englewood, where they utilize, for power purposes, the fall in the water, which has been pumped over the mountains and is later used by them in their mills and in Lead and Deadwood for domestic purposes; their second plant carries the water of Spearfish creek through five and a half miles of tunnels in the mountain sides and develops five thousand horse-power where the water is returned to the creek. The Dakota Power Company is just completing a twenty-five hundred horse-power plant at Big Bend on Rapid creek, which also carries the water from the diverting dam through five and a half miles of ditch, flume, tunnel and wood stave and in returning the water to the creek secures a fall of two hundred and seventy feet.

Dakota Power Company's Hydro-electric Plant on Rapid Creek.

Exclusive of railroads, there is a total of thirty thousand horse-power used in manufacturing and mining in the Black Hills; the above water-power plants will supply one-third of this power.

There naturally rises, the question, as to how much more power can be harnessed; assuming that thirty per cent. of the rainfall of the mountainous section of the district can be used at an average fall of one thousand feet, one hundred and fifty thousand horse-power can be developed.

Surveys already made cover the development of thirty thousand horse-power and it is safe to assume that fifty thousand horse-power will be ultimately developed at a cost of some ten million dollars. The advantage of "white coal" is seen, from the fact, that the substitution of the above power for steam coal power, would result in an annual saving in coal alone of two million six hundred thousand dollars.

Where can this power be utilized?

First: By replacing the present steam power.

Second: In future mining developments; the advent of water power in the hills will encourage the opening of new properties; of what importance the power question is to a mine operator, is shown by the expenditure, last year, of over three hundred and fifty thousand dollars for coal alone, by one of the Black Hills mining companies, and that, notwithstanding the fact that they used considerable electric power.

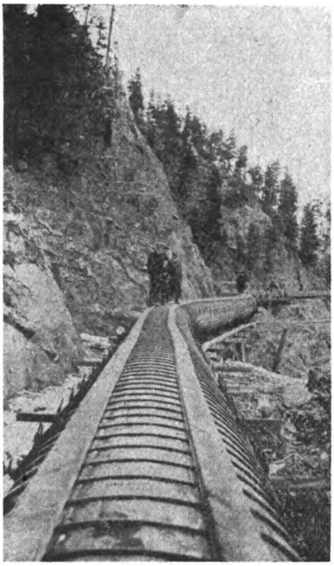
Third: In electric smelting; a very large percentage of the current generated at Niagara Falls is used in electric furnaces and recent developments in electric smelters promise that one of the serious problems in economically handling the Black Hills smelting ores is solved.

Fourth: In manufacturing establishments, which with the assistance of cheap power, will be able to utilize the immense quantity of raw materials in and around the hills.

Fifth: In pumping water for irrigation. At first thought this appears of minor importance; but a little study shows the great possibilities involved not only as a user of power but in the bringing of our semi-arid lands to the highest state of cultivation.

There is enough water going to waste during the non-growing season in the hills streams alone to bountifully water more than a million acres of land; we further have the Cheyenne river to draw on. By conserving this water and using it in the growing season, the land brought under irrigation would easily support over a quarter of million of people.

Our Black Hills district is often referred to as the Richest One Hundred Square Miles in the world; it is in prospect, but, with its untold mineral wealth, its millions of feet of timber, its thousands of unused horse-power, its streams, and its many, many acres of fertile land waiting for irrigation, one realizes the immense possibilities to be attained from the use of all the "white coal" now running to waste in the Hills; one fact is certain and that is the district could then as easily support a half million people as it now does only one-tenth of that number.



Along the Flumes.

College education in America is a commodity that is sold somewhat after the manner of life insurance and patent medicines. A large proportion of those thus attracted to the college never get beyond the freshman year.

* * *

No consideration more closely touches the progress of education than the development of a sense of responsibility on the part of colleges and universities as to their ability to conduct professional schools.

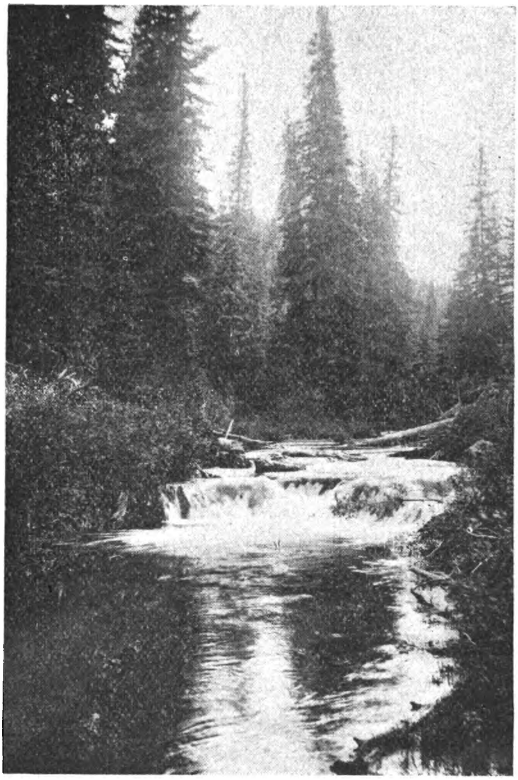
* * *

There can be no question today but that technical schools would turn out better engineers if they undertook to teach each man fewer subjects and to give him a better grounding in the fundamental sciences.

FISH CULTURE OF THE BLACK HILLS.

D. C. BOOTH

In pursuance of a law passed by Congress, February 9, 1871, creating the United States Fish Commission, President Grant appointed Prof. Spencer F. Baird, at that time Secretary of the Smithsonian Institution, the first Commissioner to investigate the diminution of the food fishes in the United States and suggest methods for restoring the supply. Commissioner Baird entered at once upon his duties and together with other scientists commenced investigations the same summer along the southern coast of Massachusetts, the two following summers were spent along the Maine Coast and in 1874



View of Spearfish Creek.

on Fishers Sound near Noank, Connecticut, returning to the southern coast of Massachusetts in 1875 for further investigations.

From the first it was apparent that the proper investigations called for the application of many sciences and the employment of specialists in order to gather accurate data upon which to base any definite conclusions of actual value to the commercial fisheries.

The same class of inquiry was practically without precedent, only three countries, Germany, Sweden and Norway having previously engaged in a similar investigation and their deductions were founded upon data collected within their own countries and not always applicable to conditions existing in the United States. Thus it will be seen that the first few years were necessarily spent largely in scientific research and the gathering of authentic information for use later on in formulating a plan of procedure. The actual work of propagating fishes was not taken up until 1872 and during the following years some attention was given to hatching shad and salmon in the coastal waters of the Atlantic as well as the salmon of the Pacific Coast and the whitefish of the Great Lakes. The following table shows the number of applications for fishes received and the species requested during the four years from 1873 to 1876 inclusive:

Year	Applications
1873	19
1874	42
1875	52
1876	174
	287

Species and total number of requests	
Shad	88
Pacific Salmon	123
Atlantic Salmon	27
Land Locked Salmon	38
Whitefish	9
Eels	2
	287

From this meager beginning in the early seventies, the United States Fish Commission, now the Bureau of Fisheries, Department of Commerce and Labor, has shown a somewhat remarkable expansion and a consequent increase in the volume of business done annually. During the year ending June 30, 1911, the Bureau of Fisheries operated one hundred and twenty six permanent and auxiliary fish cultural stations located in thirty three states and territories, ten thousand three hundred and ninety three applications for fishes were received and three billion six hundred and forty six million, two hundred and ninety four thousand and five hundred and thirty five young fishes of various sizes distributed, the railway travel of the messengers who accompanied the fish amounting to 420,734 miles. Of the above distributions, 551,499,274 were donated to the several State Fish Commissions to be planted from their hatcheries. In addition to the practical fish cultural operations, the Bureau has a large force of scientists in the field and a fully equipped ocean going vessel engaged in original research and solving some of the biological mysteries and also has charge of the fur bearing seals of Alaska.

All the above of course refers to the work of the Bureau of Fisheries in a general way throughout the whole country and probably interests the local reader less than the actual results accomplished at our home station in the Black Hills. The federal fish hatchery located at Spearfish, South Dakota, was opened for operations during July, 1899 and the following table shows the number of eggs and young fishes distributed up to January 1, 1912:

TABLES SHOWING DISTRIBUTION OF YOUNG TROUT FROM THE SPEARFISH HATCHERY*

Loch Leven Trout

	Total number distributed	Number distributed within the Black Hills Region
1900	18,500	8,500
1901	35,000	35,000
1902	14,000	14,000
1903	139,500	129,500
1904	44,500	44,500
1905	27,000	27,000
1906	78,000	78,000
1907	67,000	67,000
1908	55,000	55,000
1909	70,000	70,000
1910	68,248	68,248
1911	68,125	68,125
Total	684,873	664,873

---

*A few important "plants" have not been included. The tables give only a summary of the statistics, the detailed records of the hatchery being too elaborate for full insertion here.

Rainbow Trout

	Total number distributed	Number distributed within the Black Hills Region
1902	88,500	83,000
1903	53,000	45,500
1904	2,000	2,000
1905	43.500	40,000
1906	119,000	74,000
1907	72,400	68,500
1908	193,900	155,400
1909	135,425	125,125
1910	243.800	189,350
1911	153,000	105,000
Total	1,104.525	887,875

Brook Trout.

1900	422,000	342,000
1901	406,000	396,000
1902	312.500	262,500
1903	552,500	552,500
1904	502.000	508,500
1905	730.000	560.000
1906	763,600	650.200
1907	640.800	495,800
1908	579.600	479.600
1909	766,700	711,700
1910	689.000	611,500
1911	698,750	578,750
	7.063.450	6.149.050

Black Spotted Trout.

1899	2,000	2,000
1900	16,000	16,000
1901	377,071	377,071
1902	562,500	562,500
1903	2,094,500	1,772,500
1904	1.566,500	1,541,500

1905	1,462,100	989,500
1906	765,150	500,150
1907	1,027,776	605,276
1908	3,956,700	1,408,700
1909	522,725	443,975
1910	754,200	631,200
1911	1,312,000	1,303,500
	14,419,222	10,153,872

The total number of trout distributed to the streams and ponds of the Black Hills region since the establishment of the hatchery in the Hills is according to the above figures nearly eighteen millions. The three streams most noted for their excellent fishing, namely, Spearfish creek, Sand creek, Rapid creek have been supplied with the greatest number. Sand creek with its tributary waters has received more than half a million, Rapid creek and tributary waters approximately three millions, while Spearfish creek with its tributaries including Little Spearfish creek has received nearly seven millions.

Blackspotted Trout Eggs Distributed.

In addition to the above list of fishes distributed and planted in the public waters throughout the Northwest, about fifteen million eyed trout eggs were shipped to various places for incubation and distribution in the streams as young fish.

The National Expositions held at Saint Louis, Portland and Seattle and the public aquaria at Battery Park, New York City and Belle Isle Park, Detroit, Michigan were supplied in addition to heavy shipments to the State Fish Commissions in New York, Vermont, Pennsylvania, West Virginia, Iowa, Colorado, North Dakota, Wyoming, Montana, Utah, Oregon and Washington besides shipments to Wales and Alaska.

There is a wide-spread tradition that corporations have no souls. But of all soulless corporations, the colleges probably have the smallest compassion so far as the question of dealing with old servants is concerned.

* * *

The obligation for service performed is one thing; the question of taking on obligations for services to be performed is quite another.

WHERE THE WEST BEGINS.

Out where the handicap's a little stronger,
Out where a smile dwells a little longer—
That's where the West begins.
Out where the sun is a little brighter,
Where the snows that fall are a trifle whiter,
Where the bonds of home are a wee bit tighter—
That's where the West begins.

Out where the skies are a trifle bluer,
Out where friendship's a little truer—
That's where the West begins.
Out where a fresher breeze is blowing,
Where there is laughter in every streamlet flowing,
Where there's more of reaping and less of sowing—
That's where the West begins.

Out where the world is in the making,
Where fewer hearts with despair are aching—
That's where the West begins.
Where there's more of singing and less of sighing,
Where there's more of giving and less of buying,
And a man makes friends without half trying—
That's where the West begins.

—Denver Republican.

Perhaps the most striking feature of university growth in the United States in the past two decades has been the remarkable rise of the graduate school. This may be noted from the registration of 8,776 resident graduate students in 1909-1910 as compared with 5,831 in 1899-1900.—an increase of 50 per cent. in the decade.

* * *

If college alumni influence is to make for a better form of college, then college loyalty must take on somewhat more of real devotion to the cause of education and of the intellectual life, and a relatively smaller devotion to the promotion of successful athletics, or other forms of college aggrandizement.

EDUCATIONAL FACILITIES OF THE BLACK HILLS.

PRESIDENT F. L. COOK.

The following article is an extract from a most excellent paper given before the members of the Black Hills District meeting of the South Dakota Development Association by President Cook, of the Spearfish Normal, a school which has done much to aid in the educational development of the Black Hills.

"Seventy years ago American schools were poor indeed. Private schools were preferred to public schools. A majority of the people were opposed to free school supported by taxation. To be illiterate was no reproach. But since the Civil war our schools have improved rapidly. Our cities have vied with one another in erecting beautiful and sanitary school buildings, and in providing good teachers and competent supervisors. Our people, in truth, are taking a vast and steadily increasing interest in education, an interest which I believe will never abate until our schools become at least equal to those of the most progressive countries of Europe.

WEAK PLACES.

"There are, however, still some decidedly weak places in our school systems, which it is incumbent upon us to strengthen with the least possible delay. These defects have excited much interest and received much attention for at least ten or twelve years past, and numerous efforts are already in progress to remedy them.

"One of these defects is that our schools have not been sufficiently practical. They have educated the boys and girls away from the shop, the farm, and home-making. The courses of study have planned for the five per cent or less of the students headed for the professions, instead of for the masses who must earn their living by labor that necessitates the soiling of the hands. The prospective wage earners, those who are to enter the industries as workmen, and the country boys and girls, have been forced to take, in the schools, what was provided for others, or to do without. The result has been that an undue proportion of young people have been led into the professions; that to work with one's hands has been looked upon as disgraceful; that many of our boys become loafers, dudes, card players, cigarette fiends, gang leaders; and the girls, readers of trashy literature, addicted to dress and society only.

All this has naturally and perhaps inevitably come about through the marvelous social and industrial evolution of the past twenty-five years. Formerly the home furnished wholesale tasks for the boys in both city and country. Elsewhere the home was a workshop, as well as a dwelling. Most of the common articles now sold in the stores, clothing, shoes, soap, candles, butter and cheese, furniture, etc., etc., were made in the homes. Town life did not differ materially from that in the country. Every child found plenty to do as soon as able to work.

In addition to the large number of excellent high schools in the Hills, we are fortunate in having two still higher institutions of learning the School of Mines, and the Normal schools.

EXCELLENT SCHOOL OF MINES.

So far as I know there is not another School of Mines in America, so favorably located, geologically and mineralogically speaking, as the one in this city. That is to say, the professors and students of this institution have at their elbows of easy access a greater number and variety of geological formations and of minerals than is afforded in any other known region of like extent. It is no news to any person present here today that the school is in all ways well equipped and very efficient. It is an institution of which every citizen of the Hills and the State should be proud and for which we can all honestly and earnestly boost. It merits larger appropriations from the state than it is getting, a larger patronage by the young men of this region, and it needs only to be better known to get many more students from abroad.

One may well hope that the next ten years will see real progress toward carefully thought out and well conducted state systems of education. The first steps would seem to be an educational study of the particular state, of its schools, of the industries of its inhabitants, and of the approximate needs that the state is likely to feel in the various vocations and professions. Following such a study, the state might well lend itself to the gradual development of a system of schools which shall undertake to minister to the whole population of the state, both in the larger educational sense and in the vocational sense.

A SPECIFICATION FULLY MET

The *Engineering News* of May 2 prints the following anonymous communication, which has all the earmarks of a twentieth century satire:

"Sir:—Is the gentleman who recently published the following want ad. in your columns one of those who has been so ably discussing the compensation of engineers?"

PRIVATE ENGINEER wants assistant. Requirements: Graduate civil engineer (preferred), single man with good habits; must be experienced in mine surveying, farm surveys, and development of coal lands; must be neat draftsman and good letterer, able to do some designing and construction work; duties will be office work, mine surveying, land surveying, superintending construction and municipal engineering; man must be a hustler and work for employer's interest; will pay $75.00 per month and expenses away from Indiana. Do not make application for this job unless you can fill the bill in every particular. Send sample map work and lettering with application.

"Oh, I'm a graduate C. E.,
My habits are the best;
I never have been married,
And I'm always neatly dressed.

"I'll drive a tunnel true to line,
Compute the labor cost,
And make a dam so blooming tight
There'll not a drop be lost.

"And I can take topography,
Cross-section cut and fill.
And if you want a bridge designed,
Why I can fill the bill.

"My middle name is 'Hustle' fast,
Your interests are my own;
I'm a shark at mine surveying,
And I'll starve without a groan.

"At city work I'm expert,
And never want my pay;
Seventy-five per looks big to me,
I'll make it less by the day!"

TIN: OCCURENCES IN THE BLACK HILLS AND METHODS OF ANALYSIS.

A. ALDER.

The existence of tin in the Black Hills was first made known in 1878 by Dr. Richard Pearce, of Denver. Some gold ore sent to him contained a black sand, which he identified as cassiterite. The announcement attracted little attention, however, until the year 1883, when the existence of tin was conclusively proven through efforts of Maj. H. S. Simmons. The discovery was made at the Etta mine, originally located for mica.

The tin bearing rocks as now known are confined to two districts, the Harney Peak district, in Pennington and Custer counties, and the Nigger Hill district, in the Northwestern Hills.

The cassiterite is found in place and as stream tin in both districts. When in place the cassiterite occurs in pegmatite dykes or veins. These dykes generally conform to the schistosity of the enclosing slates. The line of demarcations between the dykes and slates is sharp and well defined. The chief characteristic of the veins is the extremely coarse crystallization of the minerals present. The veins of the Northern Hills are generally of tabular form and range in width up to sixty feet and over, and up to several thousand feet in length. In the Harney Peak district the veins are usually lense-shaped, a succession of these lenses occurring along the line of strike.

The Etta vein is the best known in the Harney Peak district, and presents some interesting characteristics. It is roughly eliptical in cross section, with major and minor axes of about 200 and 150 feet respectively. The inner portion of the vein is composed of quartz and feldspar barren of cassiterite and surrounded by a zone of albite and mica (greisen) carrying the greater part of the cassiterite. Next occurs a zone composed principally of large well-formed crystals of spodumene. Some of these crystals are extremely large, one having been found which measured 42 feet in length and 3x6 feet in cross section. The interstices between the crystals are filled with albite carrying some massive cassiterite. Surrounding the spodumene and next to the schist walls occurs a zone of micaceous material barren of tin.

Some of the more important minerals found associated with the cassiterite are, columbite, muscovite, tourmaline, spodumene, beryl and garnets. About forty other minerals have been listed, including several found only in the Black Hills. The columbite occurs in large masses, one mass obtained from the Bob Ingersoll claim weighting nearly a ton.

PERCENTAGE OF CASSITERITE PRESENT.

The amount of tin present in the ore is a hard matter to determine. The estimation of the grade of the ore by mine sampling is, as a result of the peculiar mineralization, practically impossible. Carpenter estimates that if all the rock containing ten pounds or over of black tin per ton, be sent to the mill for treatment, the probable average of the ores would be two per cent black tin.

The Harney Peak Mining Company was the first company to mine and treat tin ore in the Black Hills. The first mill erected was of 200 hundred tons capacity. The ore was concentrated by means of tables. Most of the mica was screened out before the table concentration. It was thought at this time that the tin ore was not ameniable to concentration by jigs. Investigations carried out at the School of Mines, however, showed that the ore gave excellent results by jigging. A test run made on several tons gave the extremely high saving of 95 per cent cassiterite. The concentrates assayed 68 per cent tin.

Several mills were subsequently erected by the Harney Peak Mining Co.; and large sums of money were expended in purchasing claims and in exploration work. Several thousand tons of metallic tin were produced, but due partly at least to unwise management and extravagant methods, good results were not obtained and the company was forced to cease operations.

Several years ago part of the property of the Harney Peak Mining Co was taken over by the Pahasa Mining Co.; and in 1900 a force of men were employed in cleaning out tunnels, opening and renovating shafts and sampling. The average of all samples taken along exposures indicated a value of 1 per cent cassiterite. The mine was not brought up to the producing stage, and during the past year nothing of importance was developed.

In the Nigger Hill district the Tinton Milling Co. are the principal operators. A mill of 150 tons capacity has been designed. The ore is carried from the mine to the mill by a one-half mile aerial tramway, dumped into a receiving bin, passed through a No. 3 Gates crusher, and then elevated to a 150 ton bin. It is then run through two smaller Gates crushers, and elevated to a 100 ton crushed ore bin. From this bin it is fed by a Challenger type feeder to a dry elevator and raised in a 5-8 inch shaking screen, oversize to roll No. 1, undersize to roll elevator and thence to Woodburg jig. Products from rolls are returned by a dry elevator to the screen. The product from the first jig compartment is shipping concentrates. The heads from the second and third compartments go to Wilfley tables. The middlings from all three compartments are ground in roll No. 3 and returned to jig. Tailings from all three compartments and from tables go to waste. A callow cone is used to concentrate slimes from the first compartment and they are then concentrated in a Wilfley slime table, as are also the middlings from the first tables. The heads from the tables and middlings from slime table are shipping products.

Practically no work was done in this district during the past year.

METHODS OF ASSAY.

In the Black Hills, fire assay methods for tin have been used almost exclusively. Of these methods the cyanide fusion is probably the best. The Cyanide Method, Fulton's Manual of Fire Assaying, is as follows:

The ore is crushed to 40 mesh, crushing and screening succeeding each other at frequent intervals in order to avoid sliming of the cassiterite. If low grade, 1000 grs. of crushed ore are weighed out and carefully panned in a gold pan. The first pannings are saved and repanned. Some garnets, feldspar, wolframite, columbite, etc., will probably be found with the concentrates. After panning the concentrates are placed in a porcelain dish, dried and roasted at a bright red heat, in order to decompose sulphids and sulphates. While still red hot, the concentrates are poured into a beaker of water in order to make the garnets and other silicates soluble. Water is then decanted off and the concentrates treated with aqua regia, then filtered and dried. If quartz is present, the concentrates are now treated with HF in a platinum dish. Concentrates are then crushed to pass a 100 mesh screen.

Two grams of powdered cyanide are tamped into a 20 gram crucible and the concentrates (which should weigh about 10 grams) mixed with 30 grams more of cyanide and placed in the crucible. A 5 gram cover of cyanide is then added. The crucible is then placed in the muffle at a full red heat (750° c) and kept at this temperature for 15 or 20 minutes. The temperature should not be so high as to cause the cyanide to boil and evolve heavy fumes; and if too low, the tin will not collect in a button. If the concentrates were not clean, the fusion will take longer. The crucible is removed from the muffle, allowed to cool, and the button recovered by breaking the crucible. The button should be white and soft, if not it probably contains impurities. The cyanide used must be the purest obtainable. Such impurities as K_2CO_3, sulphates, sulphides, cause serious losses in the assay.

The chief reasons for inaccuracies in the assay are:

1. Some of the tin reduced from the oxide, is apt to be volatilized at the temperature necessarily employed.
2. Metallic tin may be slagged by alkaline carbonates used in some of the methods of assay, forming stannates.
3. Foreign metals present in the ore are apt to be reduced and enter the button.
4. Sulphides present carry tin into the slag. If sulphates are present, they are reduced to sulphides.
5. Silica and silicates, always present in the ore, even after very careful concentration, carry tin into the slag, as silicate, while the SnO_2 passes thru the lower stage of oxidation in being reduced to metallic tin.
6. The cassiterite before reduction, is apt to combine with basic fluxes present in the assay, and be carried into the slag as stannates.

LOW'S MODIFICATION OF PEARCE'S METHOD.

Weigh out 0.5 gr. of finely ground ore and place in an iron crucible of about 60cc capacity, provided with a loosely fitting porcelain cover. Add a few drops of water and about 8 grs. of NaOH Cover crucible and heat very cautiously at first until moisture is expelled and then with full flame of the Bunsen burner until quiet fusion is attained. Remove cover and pour the melt into a metallic dish floating on water. Put a little water in a 5¼ inch casserole, place the hot crucible in it and heat to boiling. If the inside of the crucible contains any undissolved melt remove with weak HCl. Now add the detached cake and cover it with the crucible cover. Cover the casserole, add about 30 cc. of strong HCl and heat to boiling. When the cake is dissolved, wash crucible cover and glass and transfer the solution, which should contain no residue of undecomposed ore, to an Erlenmeyer flask, add 50 cc. strong HCl and then dilute with hot water to 200 cc. Prepare a piece of sheet nickel by rolling a strip about 7 inches long and 1 inch wide into a loose coil. Attach to a nickel wire and lower into the flask. Heat to boiling and maintain in gentle ebulition for 20 minutes, when the tin will all have been reduced to the stannous condition. Remove from heat and add a small piece of marble, and rapidly cool flask in running water. When the liquid is at room temperature, remove the nickel coil, and rinse off with dilute HCl. Add a little starch solution and titrate at once to a permanent blue with N-10 iodine solution. None of the ordinary constituents of ores interfere with this method.

Ores containing pyrites should be given a preliminary treatment with aqua regia. Evaporate the aqua regia mixture to hard dryness, take up in dilute HNO_3, filter off insoluble residue containing the tin, ignite in the crucible to be used for the fusion and proceed as above

This method with slight modification has been employed on many different ores and concentrates in the School of Mines laboratories and has given excellent results.

For concentrates the time given for reduction, 20 minutes, was found to be too short. In order to be certain of complete reduction it was found necessary to allow 45 minutes after the disappearance of the iron color.

As recommended by R. J. Morgan, horseshoe nails were also used in the reduction and found to be equally as good if not superior to the nickel. Very little carbon separates and no filtration is necessary.

For the analysis of the Black Hills ores a 1 gr. sample was used and the first addition of HCl increased to 60 cc. Owing to the high silica content the HCl should be added quickly in order to prevent the separation of silica.

Tungsten is sometimes found in the Black Hills' ores, and when present always gives high results owing to its oxidation by iodine. The oxidation is slow and gives an indefinite end point. Columbite though reduced is not oxidized in the titration.

ELECTROLYTIC METHODS FOR ORES OR ALLOYS.

If an ore, fuse with Na_2CO_3 and S, extract with water and filter. Add acetic acid and an excess of oxalic acid to the filtrate. Warm and saturate with H_2S. Arsenic and antimony are precipitated and tin is left in solution. Filter, drive off H_2S and electrolize with a current density of .3-.06 amperes and 2.8-3.8 volts, at a temperature of 25°-30°c. The volume should be about 120 cc.

If an alloy dissolve in HNO_3 also tartaric, if antimony is present) and heat gently. Neutralize with NaOH and then add an excess. Add an excess Na_2S and filter off the CuS and PbS formed. Add acetic acid to the filtrate and an excess of oxalic acid. Warm and saturate with H_2S. Filter from arsenic and antimony sulfids, drive off H_2S and electrolize as above.

The time required for complete deposition of the tin is about 9 hours. With a rotating anode the time can be reduced to 20 minutes. The tin deposits in a brilliant white adherent form.

Tin may also be deposited with good results by the electric current from an ammonium sulfid solution.

MILL RUN.

Togged out in the rather characteristic attire which they had discarded with the muckstick last September, the Seniors and Juniors of the S. of M. got together on Monday, April 29th, to put into practical operation some of the principles and theories which they had been absorbing during the several years previous.

This was the occasion of the annual week's mill-run. The boys were assigned to different duties on different days, the positions to be filled being as follows: Foreman, amalgamator, feeder, classifier, table man, vanner man, assayer and roustabout. It is needless to say that under this arrangement the men always received fair treatment from the foreman, because if they did not, they had the chance of getting back at him, so to speak, when his turn as roustabout came.

The material treated was a free milling quartz ore from the southern hills. This was first crushed in a Gates gyratory to pass a 1½ inch ring. The crushed material after being thoroughly sampled was taken, by means of a hydraulic elevator, to the feed floor. From here, through an automatic feeder, it was fed into the stamp battery. It was found by tests that crushing to 30 mesh was sufficient to liberate all free gold. Careful panning tests made on the tailings from the twelve feet of plates failed to show any losses, of values susceptible to amalgamation. Inside amalgamation was also used, small amounts of quick being fed into the mortar with the ore, also an inside plate called the chuck was used.

The tailings from the plates consisting of coarse and fine sands, sulphides of iron, lead, arsenic and antimony, and slimes, were then passed through two hydraulic ore classifiers, the first taking out the coarse sands and heavier concentrates, and passing them into a Traylor concentrating table where a complete separation of sands and concentrates was made. The overs from the first cone, consisting of fine sands and lighter concentrates together with all slimes, were passed to a second cone classifier where a complete separation of the fine sands and concentrates from the slimes was obtained. The slimes carried no values, so were run to waste. The heavier material from the cone was run onto a vanner where also a clean separation of sands and concentrates was made.

Ready for the Mill Run.

The different operations on a small scale were exactly the same as those practiced at many mills, and all adjustments and experiments, and problems to be solved were as practical and difficult as any found in large mills treating a similar grade of ore.

After the first two days' run a cleanup was made every day and on the Saturday following, a complete cleanup of amalgam from mortar box and plates, and of all concentrated materials was made. The concentrates, consisting of pyrite, pyrhotite, arsenopyrite, and galena, carrying about 30 per cent. of the gold values, were sacked. In practical operation these concentrates are sent to a smelter where they are treated for the lead, gold, and silver values they contain.

The run as a whole did not give the observer the impression that it was being made for practice only, for all of the fellows had "been there" before, and the fact that all of the men had gained valuable experience, along similar lines, in actual field operations, during the previous summer's vacation, accounts to a large extent for the success of the run.

A LIST OF MINERALS AND ROCKS OCCURRING IN THE BLACK HILLS.

The Black Hills are often referred to as being favored with an unusual variety of minerals and rocks. For the benefit of those interested the following list is given: It contains all minerals and rocks believed to have been identified with a fair degree of certainty.

Minerals

- Altaite
- Amblygonite
- Amphibole
    - Actinolite
    - Asbestos
    - Hornblende
    - Tremolite
- Analcite
- Andalusite
- Anhydrite
- Apatite
- Aragonite
- Arsenopyrite
- Autunite
- Azurite

- Barite
- Bentonite
- Beryl
- Biotite
- Bismuth
- Bismutite

- Calcite
- Cassiterite
- Cerargyrite
- Cerussite
- Chalcocite
- Chalcopyrite
- Chlorite
- Chrysocolla
- Columbite
- Copper
- Corundum
- Cuprite

- Dolomite
- Epidote
- Feldspar
    - Andesine
    - Anorthoclase
    - Albite
    - Labradorite
    - Microcline
    - Microperthite
    - Orthoclase

- Fluorite

- Galena
- Garnet
    - Almandite
    - Grossularite
    - Melanite
- Gold
- Gold telluride
- Graphite
- Greenockite
- Griphite
- Gypsum

- Halite
- Hauynite
- Hematite
- Heterosite
- Huebnerite

- Ilmenite
- Iron, meteoric

- Jamesonite
- Jarosite

- Kaolinite

- Lepidolite
- Leucite?
- Leucopyrite
- Liebnerite
- Limonite
- Loellingite

- Magnesite
- Magnetite
- Malachite
- Manganite
- Marcasite
- Melanterite
- Meneghinite
- Mica
  - Biotite
  - Muscovite
  - Phlogopite
  - Sericite
- Molybdenite
- Monazite

- Natrolite
- Nephelite
- Niccolite
- Noselite

- Olivenite
- Opal
- Ottrelite
- Petalite
- Piedmontite
- Prochlorite
- Purpurite
- Pyrite
- Pyrargyrite
- Pyroxene
  - Aegerite
  - Augite
- Pyrrhotite

- Quartz
  - Agate
  - Amethyst
  - Aventurine
  - Chalcedony
  - Chert
  - Flint
  - Greasy Quartz
  - Jasper
  - Rose Quartz
  - Smoky Quartz
- Ripidolite
- Rutile

- Scheelite
- Scorodite
- Selenite
- Siderite
- Silver
- Sodalite
- Sphalerite
- Spodumene
- Stannite
- Staurolite
- Stibnite
- Sulphur
- Sylvanite

- Talc
- Tantalite
- Tapiolite
- Tenorite
- Tetradymite
- Titanite
- Torbernite
- Tourmaline
- Tremolite
- Triphylite
- Triplite

- Uraninite
- Uranocircite

- Wad
- Willemite
- Wolframite

- Zincite
- Zircon
- Zoisite

ROCKS

- Amphibolite
- Andesite
- Angite-Fourchite
- Augite-Vogesite
- Bostonite

- Chlorite-Schist
- Coal
- Common Clay
- Conglomerate

- Dacite
- Diorite
- Diorite-Porphyry

- Fire Clay
- Garnet-Schist
- Gneiss
- Granite
- Graphitic Schist
- Greisen
- Greywacke
- Grorudite

- Hornblende-Schist

Infusorial Earth
Itabarite

Lamprophyre
Leucite-Phonolite?
Leucitophyre?
Limestone

Mica-Diorite-Porphyry
Mica-Schist
Mica-Slate
Monzonite-Porphyry
Muscovite-Granite

Nephelinite
Nepheline-Syenite

Ottrelite-Schist

Pegmatite
Petroleum
Phonolite
Phyllite

Quartzite
Quartz-Aegerite-Porphyry
Quartz-Schist

Rhyolite
Sanadine-Trachyte
Sandstone
Shale
Slate
Staurolite-Schist
Syenite-Porphyry

Tinguaite
Tonalite
Tourmaline-Granite
Tourmaline-Schist
Trachyte
Trachytoid-Phonolite

There are 691 degree granting colleges and universities in the United States.

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Too many university men know more about the sporting page than they do about good reading.—*Prof. C. C. Arbuthnot.*

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There are 12,000 workers employed in the lapidary shops in Antwerp who receive an average wage of $20.00. Ansterdam has 10,000 diamond cutters, some of whom receive salaries of $120.00 per week.

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Tannic acid is being used in experiments carried on at Toronto by the Provincial Engineer of Highways for treating clay roads. It is claimed that this treatment will give a wonderfully hardened surface which will last well and will not readily be softened even by persistent rains.

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The largest gold nugget ever found was the "Welcome Stranger," weighing 2,280 oz., found near Moligul, Victoria. The "Welcome Nuggett," weighing 2,166 oz., from Ballarat, the "Blanche Barkly," 1,743 oz., from Kingstown; the "Canadian," 1,604.8 oz., from Ballarat, and numerous nuggets of over 1,000 oz. were found in Victoria. One nugget of 36 lbs. weight was found in the Urals.

EDUCATIONAL ADVANTAGES OF RAPID CITY.

SUPT. J. R. BYERS.

With a liberty loving people, educational privileges of any kind are considered advantages. Ambassador Bryce asserts that the one thing in American institutions which stands out preeminent is the success which has been made of public education. Nowhere else in the world, he assures us, are the masses so intelligent and so keenly alive to the privileges which are theirs. This we feel to be a just tribute to our great public school system, and by one whose insight and judgment can not be questioned.

Rapid City's school system stands on a par with that of most western cities of her size. Through the eight grades of the common school, an excellent course of study is pursued, meeting in every way the requirements of the state law, but with a far fuller application in many of its details, as well as elaborate supplementary work in practically all subjects. All the fundamentals are carefully taught besides a considerable amount of work in the artistic and the ornamental. Manual arts are being developed rapidly. Through the first five years well organized courses are maintained. In the sixth, seventh and eighth years, bench work for boys and needle work and elementary cooking for girls are just now being introduced. While plans are in consideration looking to constructive work in the physical development of pupils. Buildings are adequate and conveniently located. Two new modern, brick buildings have recently been erected. Others are planned for soon to meet the rapidly growing needs of the city. The High School is growing very fast and is rapidly taking on cosmopolitan conditions. Full standard courses are run as follows: Four years of English, four of Latin, three of German, three of Science, three of Mathematics, two of History and one of Bookkeeping. It is probable that another year of Science-Chemistry, will be added next fall, as also one of History. The High School is accredited with the North Central Association of Colleges and Secondary schools, and its graduates are received without examination by such institutions as Oberlin and Smith Colleges and the Universities of Michigan, Illinois, Wisconsin, Minnesota, Iowa, South Dakota, and others.

Rapid City has just voted a considerable bond issue, to start the erection of a new High School building to cost not less than $100,000.

This building when completed will be modern in every respect and is to be fully furnished and equipped. It will accommodate a High School of about 400 students, and give Rapid City a secondary school second to none in the middle west.

But the pride of Rapid City's educational institutions is the State School of Mines. The school is maintained by the state, is of college rank, and offers courses of unusual strength, especially in mathematics and science, in which last it grants the bachelor's degree. A young man considering any line of engineering as a future could scarcely do better than to complete a course at this institution, for with the general courses he would get here in science and mathematics he could speedily specialize in any line of engineering. As a school of mines, which this institution is, primarily, there are very few in the entire United States its equal, and none its superior.

Especial emphasis is placed on the study of Chemistry, Physics, Mathematics, Geology, Mineralogy, Economics, English, Engineering, Mining and Metallurgy. The laboratory and library equipment of the several departments is excelled by few institutions of the kind in the country. The school has one of the finest geological museums west of the Mississippi river and many of its collections of Black Hills' minerals, rocks, ores, and fossils have never been equalled.

Besides the well articulated school system above described,—from the primary school through the college,—two private institutions are offering their opportunities to Rapid City's young people. The one, Brown's Business College, is a school for commercial instruction, covering the usual lines of bookkeeping, stenography, typewriting, Business Arithmetic and usages, commercial laws, and The quality of instruction offered is high class, and the service which has been rendered the community thus far has been eminently satisfactory. Young people completing courses at this institution may depend upon it that they will be able to both, "get jobs" and to "keep" them. The school enjoys a liberal patronage, both within and without the city and is rapidly outgrowing its present quarters. Rapid City's second private institution, is in prospect rather than a reality. Still leases have been signed for a Military Academy to occupy a large structure near the city, originally erected by a religious denomination for an Indian Mission School. A considerable amount of work has already been done in refitting and changing to meet the new needs The institution is expected to open in September with an enrollment of from 60 to 100 boys.

No article of this nature is in any way complete without at least a mention of the Indian School situated just west of the city. While not an institution receiving white children, it is nevertheless a school of high standing maintained by the United States government for the education of Indian children in South Dakota. Some Indian schools are but temporarily maintained, while others are intended to be permanent. This at Rapid City is of the latter kind, and the federal government is expending annually large sums of money to complete the erection of an efficient plant, that the children of the passing Sioux may become independent and useful American citizens.

So from the above it may be seen that Rapid City's claim to being an educational center is no mean boast for so young a community in so new a country.

THE human mind should not be a granary for storing the wheat of knowledge. It should be an engine for grinding that wheat into flour for the sustenance of man. The great purpose of education is to make the thinker. The knower is the man who would know the facts of a certain occurrence. The thinker would see the relationship of those facts. He can weigh evidence; he has not only vision, but circumvision. The implication that knowing is education is an exploded theory. Consider Darwin, John Stuart Mill, Huxley, Matthew Arnold, Tennyson and Browning. Do you think those men would claim knowledge of all subjects? Darwin admitted that in his work he had lost an appreciation of music. Mill's mind was simply a thinking machine. The college's primary purpose is to train a man in the knowledge of social and human phenomena, so that coming from college he may apply his disciplined mind to remedying their evils, to lifting humanity higher. That is done, not by learning, but by thinking.—*Pres. P. F. Thwing,* Western Reserve University.

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IT is claimed that the Russian government has decided to tunnel the Caucasus mountains near Tiflis in order to join the Black and Caspian seas. The tunnel will be sixteen miles in length and about seven years will be needed to complete it. A Paris firm of bankers is supporting the enterprise, which will be under the control of Swiss engineers. Work will be begun in the early part of 1913.

THE SCHOOL OF MINES.

M. A. LANGE.

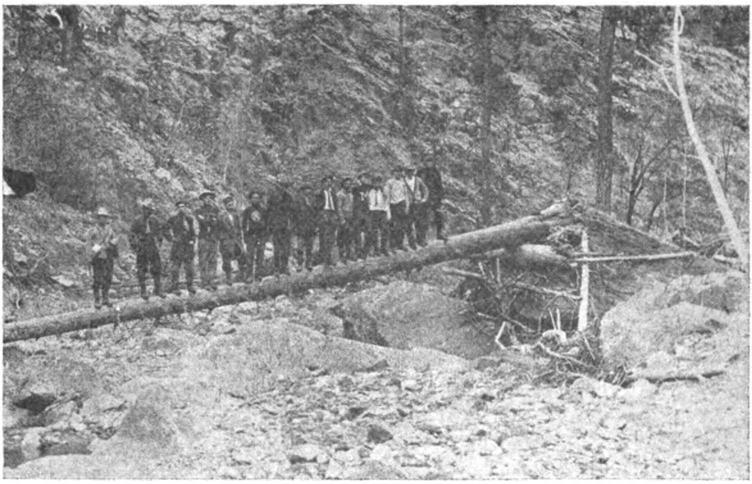
The School of Mines of South Dakota is one of the best equipped institutions of its kind in the United States. It is the only one of its class, in this great commonwealth and therefore belongs to the entire state; it is the only school in this state that trains and prepares its students to develop the unlimited natural resources of the Black Hills.

Its graduates do not need *to wait* for paying positions, the supply is not equal to the demand. The University of Chicago, Stanford University, Case School of Applied Science and several schools of lesser note have elected some of its graduates to professorships and instructorships. Many more of these young men have filled and are filling places of trust and responsibility in their engineering profession. Some are managers or superintendents of mining properties, others fill subordinate positions as assayers, chemists, and mine surveyors. Of last year's class, one has secured, through competitive examination, employment in the Municipal Engineering Department of Portland, Oregon.

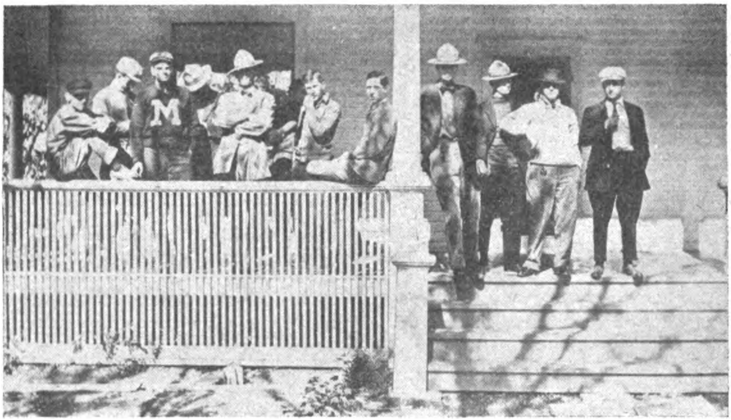
Thus these institutions and corporations are calling for the "finished product" of this school where men are made familiar with the latest attainments of modern science. In almost every instance where these young men have not received or secured positions in higher institutions of learning, they are earning and receiving excellent salaries for their services in other lines; for these young men have been taught that honest toil is honorable, and every person should be able to earn an honest living.

This institution deserves the encouragement and support of every fair minded citizen; every one who believes developement makes mankind morally and socially better. President Cleophas C. O'Harra with his corps of fifteen very able and efficient instructors and their assistants, need no words of commendation from me, more than "by their works ye shall know them." Reader, if you will judge them from this view point your verdict will be good.

ALL public clocks in Germany will hereafter be synchronized by means of wireless telegraphy. A master clock is being constructed near Fulda, which will actuate the radiotransmitter every minute. The tower over the station will be 300 feet high.



Everybody Look This Way.

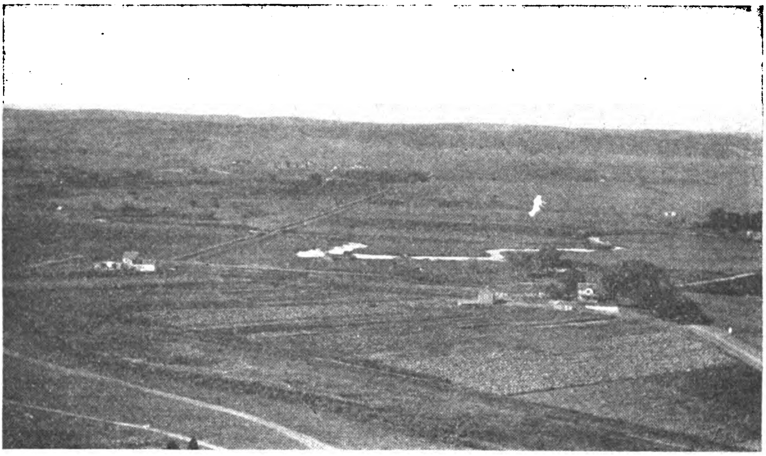


The Owl Club.

RAPID CITY: NATURAL RESOURCES UNLIMITED.

HARRY WENTZY.

Considering the limitations of an article that would make but two thirds of newspaper column, one can only hope to tell about the natural resources of Rapid City and its tributary territory in a sort of a hop, skip, and jump manner. Therefore, I shall eliminate any introduction, and go at my task very much the same as a carpenter goes at a house after the foundation has been completed.



Looking West from Hangman's Hill.

First of all, one of the greatest assets of Rapid City is the building material which is found in the territory adjacent to the city. This includes lime, gypsum, all kinds of building stone, pine lumber, akin to the white pine, which is getting scarcer every year; cement deposits; brick clay, with its brick and tile possibilities.

Next in importance, is the fact that this region is admirably adapted to agricultural and grazing pursuits. There are fertile valleys in which can be raised fruit, grains of all kinds, vegetables, and where alfalfa, the most nutritious forage plant yet discovered, finds a congenial soil. Then there are the uplands, known as table lands, which are fertile and are the best cattle lands known anywhere. In explanation of cattle lands let it not be understood that these lands are not tillable, and are not productive of good agricultural products, for such an assertion would not be true. But the valleys, with their spring water creeks, which irrigate the valley lands, become of much greater value for farming purposes. The fine creeks ought to be used as general supply sources for immense irrigation reservoirs, with which to irrigate the thousands of acres of uplands in times of need. If this should be done, I take it from a conservative estimate made by a man who says that a million dollars worth of water runs to waste in Rapid Creek every year. Who will deny the fact? This is merely computing the value of the water should it be stored up and placed upon the high lands at times of the year needed by growing crops.

Hangman's Hill.

Speaking of the value of water going to waste has no consideration for the immense value of water power that can be and is being developed on Rapid creek at the present time. Within the next few years there should be a demand for many thousands of horse power, and if this should come true, then the water power of Rapid creek can be computed by the millions, rather than thousands of dollars.

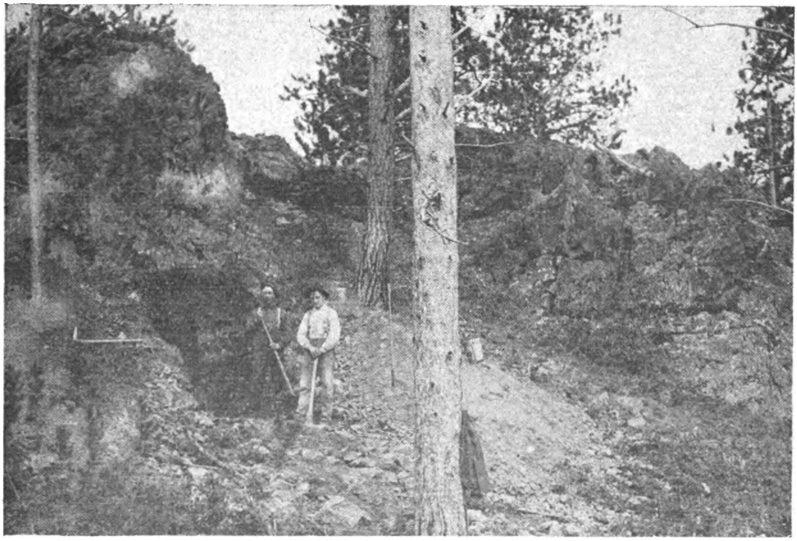
Railroads radiating from the busy center of western South Dakota, with more to come, must appeal to every man, and convince him that eventually Rapid City will become a commercial center of no mean dimension.

Minerals tributary to Rapid City? Yes, in untold quantities, and representing untold wealth. Healthful climate? The best that the land can afford. Splendid scenery? None to excel, not even in the Swiss Alps, where the touch of nature's artist has not been more keen to the requirements of the nature loving tourist.

THE MINING ENGINEER.

FRANK A. FAHRENWALD.

Just who and what is a mining engineer? The profession itself is conceded to be the broadest field of engineering in the world. It presumes a knowledge of geology, petrography, crystallography, geography, trigonometry, surveying; of milling, cyanidation, amalgamation, chlorination, concentration, ore and oil flotation, magnetic separation; of lead and copper smelting, matte smelting, and refining; of hydraulics, mechanics, thermo-dynamics, and electricity; of the laws of a hundred lands and the customs of a thousand mining districts; of transportation by land, rail, train, sea or air; moreover the engineer is supposed to know all of the business tricks and schemes and devices of deceitful sellers of mines and minerals, on one hand, and the shrewd unscrupulous buyers on the other. Indeed much of the business of the mining engineer consists in writing obituary notices of schemes to sell the golden fleece. Certainly the engineer must be conversant with all of these, and much more; but does a thorough knowledge of all this make a mining engineer?



Getting Ready for the Mining Engineer.

Science is a fascinating and exacting goddess who weaves a spell about her devotees, and causes normal human emotions to disappear; the lure of gold, the dream of power, the hunger for social position are all forgotten. Impelled by strange mysterious forces unknown to the multitude and by thousands but dimly felt, they pursue truth for truth's sake. They discover realties through the insatiable desire to know. Enthralled by the passion for exploration and discovery they give profound intellectual effort, they spend lives of unsparing labor for a mere existence, often without the aid of recognition or sympathy. But this devotee of science is not a mining engineer, he lives apart and in a higher world.

However. the scientific spirit is and must always be the inspiration of the mining engineer. But is not his own life work of a different nature? It leads out of the library and laboratory and into the busy world of men and affairs. It is most sternly practical, the production of wealth from the forces and materials of nature; and, I think calls more and more, not for the intense and narrow specialist, but for the many-sided and well balanced man; for besides a thorough technical knowledge, a working knowledge of men, and skill in dealing with them, are necessary. The study of the reactions of chemistry is of no more importance than the study of those human reactions which break down differences and create friendships. Whether dealing with men or science, the true mining engineer has, bred in him, the impulse, and has the ability, to search out facts, however unpleasant they may be, and look them squarely in the face. These qualities, if combined with good sense and the ability to decide which of any two things is the more important, are the ones which go to make up the successful mining engineer.

Thus, in my sense of the term, the engineer is neither the one extreme nor the other, but one whose special work is the application of the discoveries and methods of science to the practical business of the world.

Party politics have played their part in the state institutions in the dismissal of men, notably of presidents who have stood for a sound educational policy against the popular cry for greater numbers or winning athletic teams.

* * *

The question of education, the determination of the right system of schools and of their effective coordination and conduct, is the most important question before each nation, but in no country does this question assume such importance as in a democracy in which every citizen assumes full political responsibility.

THE ORDNANCE DEPARTMENT OF THE U. S. ARMY.

J. H. STEELE.

One usually thinks of the United States Army as being divided into infantry, cavalry, and artillery, and the greater number of our soldiers will be found in one or other of these branches of the service. In addition to these, however, there are other departments, such as the Engineer Corps, to which the brightest young lieutenants are usually assigned, the Medical Corps, the Signal Corps, and the Ordnance Corps. The Ordnance Corps consists of those officers and men who serve in the Ordnance Department. They are destinguished from men in other branches of the army by wearing the insignia of the Ordnance Department, which is a spherical, flaming shell.

It is the business of the Ordnance Department to supply the rest of the army with weapons. Ordnance comprises all kinds of fighting utensils, from a pistol or a machete to a fourteen-inch sea coast gun, including revolvers, automatic pistols, sabers, rifles, bayonets, machine guns, field and siege rifles and mortars with their carriages, caissons, and limbers, and coast defense rifles and mortars with their carriages, sights for the cannon, range finders, plotting boards, and search lights, together with the various kinds and calibers of service and practice ammunition. It also includes belts, harness, saddles, blankets, and other accouterments for cavalry and artillery. The design, construction or manufacture, storage and distribution of these various items is the function of the Ordnance Department and its vast number of civilian employes.

The manufacture of all this material is divided among five arsenals; namely, Watervliet, Watertown, Springfield, Rock Island, and Frankford.

Watervliet Arsenal, on the Hudson River, near Troy, New York, makes all the cannon used by the United States army, both field artillery and coast defense. This arsenal is admirably situated for its work, being far enough inland to be immune from capture by naval landing parties, and close enough to tide water to provide easily both rail and water transportation to the sea. In the great machine shop at Watervliet Arsenal are some of the largest lathes in the United States, as well as some of the largest travelling cranes. They are built to handle a sixteen-inch gun, fifty calibers—about sixty feet—long. Only one such sixteen-inch gun was ever built at this arsenal, the reason being that the present design of fourteen-inch gun has proved to be more efficient and vastly cheaper to build. A lad, about seventeen years old, once undertook to crawl through the bore of the sixteen-inch gun as it lay at the arsenal before being shipped to its destination at Sandy Hook. He accomplished the feat, but nothing would induce him to repeat the performance.

About midway down the length of this machine shop is the shrinkage pit where the "jackets," or hoops, are shrunk on to the barrel of the gun. The jacket has its interior diameter carefully turned to a dimension a trifle smaller than the outside diameter of the barrel. It is then heated until it expands enough to slip over the barrel. The latter stands up on end in the shrinkage pit and a travelling crane picks up the hot jacket, carries it to the pit, and carefully lowers it over the barrel, where it is allowed to cool, the cooling being hastened by streams of water. The cylindrical ingots from which these parts of the gun are made usually come from the Bethlehem Steel Company. The diameters for shrinkage have to be very carefully calculated. After the gun has had its jacket shrunk on, it is bored and turned to size and then rifled. The process of rifling is interesting to watch. In small arms the rifling consists of wide, shallow grooves alternating with "lands," and having a uniform twist around the bore. Since the twist is uniform, if it were developed along an axis parallel to the bore, it would be a straight line. In heavy guns, however, the rifling consists of sharp V-shaped grooves with a twist increasing toward the muzzle. This twist, developed, becomes a well-known mathematical curve, and a slot, following this curve laid out to full size, is cut in a steel table adjacent to the rifling lathe. Into this slot fits a spline which as it moves along the curve controls, inside the gun, the rotation of the rifling head which carries the cutting tool. A copper band surrounding the projectile near its base is forced by the pressure of the powder gases into the rifling grooves and so gives the projectile its rotary motion.

Carriages for sea coast guns, both disappearing and barbette, are made at Watertown Arsenal near Boston. The machine shop equipment for making gun carriages is similar to that of any other first class, all around machine shop prepared to do heavy and accurate work. Sometimes during rush times the government contracts for the building of some of these carriages by private firms. Watertown Arsenal is noted for its great testing machine, of a capacity of one million pounds. It can handle a slender wire or a heavy column thirty feet long with equal precision. Every year a book is published giving results of the tests made at this arsenal, and they have contributed very much to the development of scientific engineering in the United States.

Small arms are manufactured at the Springfield Armory at Springfield, Massachusetts, and at Rock Island Arsenal at Rock Island, Illinois. They are usually designed at Springfield, and that arsenal has given its name to most of the models of army rifles used in this country since the Civil War. The rifle now used by the United States Army is known officially as the "Model of 1903," and popularly as the "New Springfield." It was designed at Springfield and is supposed to be the best military rifle in the world. The Krag, which was used during the Spanish war, has been entirely superseded. Some interesting figures regarding the design and performance of the new rifle might be given, but they come under the head of confidential information which it would not be the part of patriotism to publish.

During the excitement following the shooting up of the town of Brownsville by a colored regiment stationed there, some remarkable detective work was done by officers of the Ordnance Department. By means of micro-photographs taken in the drafting room of Springfield armory they were able to assert positively that certain empty shells picked up in the streets of Brownsville had been fired by the rifles held by the negro troops and to state which gun had fired each shell. The sharp point of the firing pin, which to the naked eye is absolutely smooth and polished, shows under the microscope scratches and grooves caused by the tool in its manufacture. These scratches and grooves reappeared in the soft percussion cap which had been punctured by this firing pin.

The arsenal at Springfield dates back to Revolutionary days and tradition says that the site was selected by George Washington. One of the buildings, now used for storage of arms, suggested to Longfellow his poem, "The Arsenal at Springfield." Both Springfield and Watervliet Arsenals were in use during the Civil War, and the older inhabitants of those places tell many interesting stories of the activities at that time.

Since they both manufacture the army rifle, there is considerable rivalry between Springfield and Rock Island Arsenals; but Rock Island has the advantage because of the abundance of water power there. There is some water power available at Springfield and one large machine shop is run by water, but coal must be used to run most of the shops. Recent labor troubles at Rock Island may, if they continue neutralize the advantage possessed by that plant. In addition to rifles, Rock Island makes the carriages, caissons, and limbers for field and siege artillery, also army wagons, harness, saddles, and all other accouterments made of leather.

Frankford Arsenal, just outside of Philadelphia, makes all the ammunition used in the army rifle, also sights for all cannon, range finders, and plotting boards for coast defense, as well as other apparatus of a scientific or experimental nature. Broadly speaking, nearly everything used in the army that is made of brass, or similar alloy, is made at Frankford. Cartridge shells are made and loaded by ingenious automatic machines tended by girls. A plotting board is an instrument whereby the position of a ship as to bearing and distance from a gun may be instantly plotted at the battery from angular observations telephoned from two distant points. By this means an officer in a pit below the level of the sea may point his gun and make a hit without seeing the ship which is his target.

Besides the above establishments, there are several other arsenals in the United States used for storage only, such as Augusta Arsenal, San Antonio Arsenal, and Berenicia Arsenal. The army proving ground for testing new heavy guns is at Sandy Hook near Fort Hancock.

At the head of the Ordnance Department is a brigadier general appointed by the president and confirmed by the senate. The present Chief of Ordnance is Brigadier General William Crozier, a most capable and efficient officer. His headquarters are at Washington, and most of the designing is done there, a large force of draftsmen under the direction of a staff of assistant officers being maintained for the work. Each manufacturing arsenal maintains also a drawing room of its own The draftsmen are all civil service employes. The command at each arsenal is exercised by an officer usually of the rank of colonel, who is assisted by a staff of from two to six junior officers. A force of enlisted men amounting to about one company is kept at each post for guard and fatigue duty. By "fatigue duty" is usually meant the care and maintenance of the grounds and lawns surrounding the arsenal buildings. They are always kept in most beautiful condition. Men in other branches of the army sometimes refer to the enlisted men of the Ordnance Department as "feather bed soldiers," because, even in war time their work is mostly post duty, rather than fighting.

The work of the Ordnance Department of the United States Army, going on quietly year by year, is most necessary and important for the national defense. It is a pity that it should be continually handicapped by inadequate appropriations. The officers and civilian engineers of the department are a highly trained, alert and scientific body of men who fully realize what congress does not, that the battles of the future are being won today in laboratory, drafting room and shop.

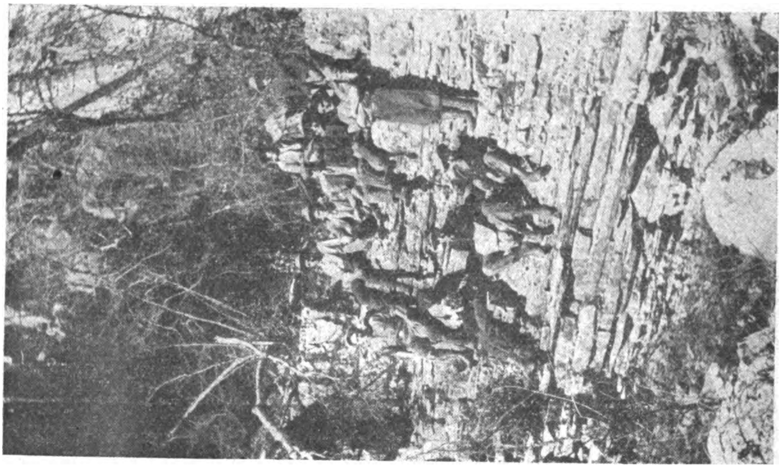
PREHISTORIC MAN IN SOUTH AMERICA

The last Yale Peruvian expedition under the charge of Prof. H. Bingham made a discovery of human bones mixed with the bones of some canine and a bison in the Andes mountains near Cuzco, Peru. Prof. Isaiah Bowman made a thorough geologic examination of the locality and carefully determined the age and occurrence of these remains. They were buried under from 75 to 150 feet of stratified gravel which represents glacial deposits equivalent in age to the Wisconsin stage of North America. Subsequent to their deposition vigorous erosion set in cutting deep gorges, near the bottom of one of which the remains were found. There is no evidence that bison ever existed in South America and almost all cases of buried human remains of great age in North America are not authentic. All evidence seems to prove that these remains are prehistoric. Conservative estimate places their age at from 20,000 to 40,000 years.—*American Journal of Science.*

Modern pension systems appeared in the nineteenth century and have shown rapid growth. Their extension to all orders of society has been a feature of the opening decade of the twentieth century. This result is due chiefly to two facts: first, to our quickened sense of humanity; second, to the clearer appreciation that such humanity means more effective service and an improved condition of society.

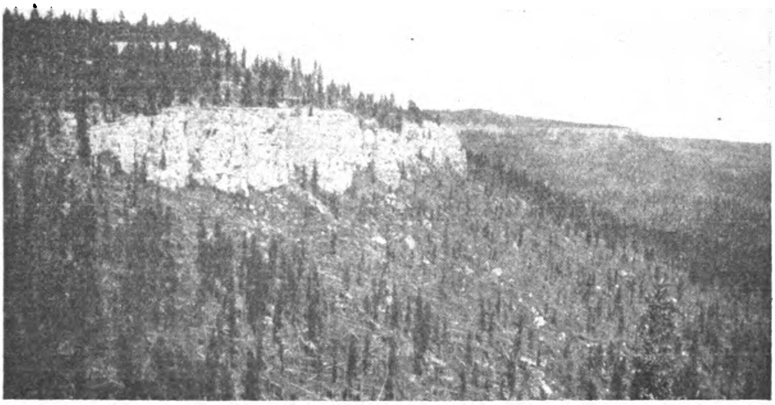
* * *

The university is becoming each decade a more powerful factor in civilization.

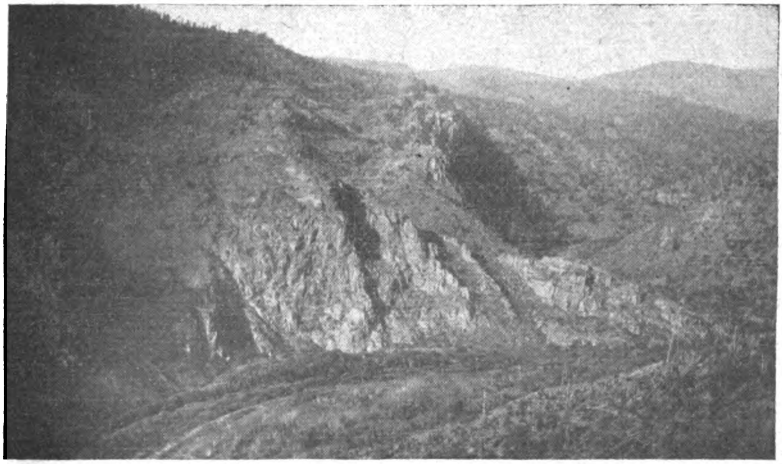


Geological Students.

Geological Students.



The Western Limestone Escarpment.



Near Silver City.

THE PAHASAPA QUARTERLY

Published by The South Dakota State School of Mines, Rapid City, S. D.

Subscription Rates...$1.00 per year

W. J. McCauley, ...Editor.
L. L. Farnham,..Business Manager.

The Pahasapa Quarterly desires to express to the business men of Rapid City its hearty appreciation of their good will and loyal support. No town in the state can boast of a better group of merchants, or of a finer lot of people. Especially noticeable has this been in the courtesies extended to the faculty and students socially, and in the unfailing loyalty shown to the School of Mines, in its efforts to build up an institution of high rank. Indeed, the people of the Black Hills generally have been equally loyal to our school and its publication. Unquestionably, however it is not too much to say that the Pahasapa has demonstrated its right to live independently of any appeal to school spirit or local pride. Magazines and technical papers of high standing have recognized this, and have made abstracts of or copied entire some of its leading articles, generally those of a technical nature. In many ways evidence has developed that the Pahasapa Quarterly has met with popular favor and interest. Many inquiries have been received in regard to this, our commencement number. Instead of answering these queries, attention is called to the publication itself. The articles printed are of a high order of merit, and the illustrations used are interesting and instructive. Some of the scenes depicted are beautiful, and reveal nature's handiwork in its most artistic form. The number, however, needs no words of commendation. It speaks for itself. The Pahasapa Quarterly will continue to grow in interest and usefulness. Already plans are being formulated for a larger and better magazine. Next year looks exceedingly promising. Until then, kind reader, adieu.

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The American Educational Review, in a recent number, voiced a thought which is exceedingly appropriate for the commencement number of the Pahasapa. The quotation in part is as follows: "A circle of a score of college graduates agreed to meet after a dozen years to test this question: How many of us have preserved the ideals with which we left college? Not that any man ever did or could live up to his ideals. But how many still found them the dominant forces in daily life? When these men actually met, comments the *New York Mail,* they had to confess their ideals had gone by the board. The pitiable admission of the lawyer, that, instead of reformatory and high-minded work in jurisprudence, he had accepted 'success' in big fees from corporations; the acknowledgement of the physician that the wealthy patient, and not science, contented him; and much more in the same line—this was the burden of the talk, after the twelve years were gone. Just the same, we do not believe that college graduates who were earnest students enough to have ideals at all abandon them in any numbers. The boyish day dream may fade. The eager courage of youth, ambition to conquer wrong, may be somewhat dulled. The bread battle is a dusty, dogged fight with us all. And the heart beats slower as time passes. Then, too, there are other objects of kindling affection—the man's family, for instance. Many are hurt in the struggle, and with failing or repaired health, must go slow, if they go at all. But the college dream remains, to all who ever had it. It is the one best thing in college and by the college. The boy is toned higher. He hopes for more, even if he cannot reach more. If he is not working for his ideal, he yet is one of the all-too-small audience who sees and cheers it in others. He helps to keep his ideal on the earth, and he teaches it to his son. The civilization of a nation is now in everybody's possession. But the enlightenment and the refinement of a people are lodged with its educated men and women. That there are many in that class who are not college graduates is happily true. But it is evident that the colleges, with their large annual output of young men and women, mainly recruit the educated class of a country. No college man would part with his boyish ideal of what great and good things he would do. The moonlit campus had long shadows, and the shadows are pointing still. The song round the tree is sounding yet, and many's the day when the force that saves is the deathless dream of college days, to be and do our best."

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PRESIDENT KING of Oberlin College has undertaken, with the the cooperation of four faculty committees, to secure some working tests of academic efficiency. Briefly stated, the results are as follows: A revised curriculum and higher standard for graduation; improved methods of choosing students and of registration; provision for closer supervision of student scholarship; and certain advances in the development and adjustment of administrative machinery. It is notworthy that the School of Mines, through its faculty committees, reached similar conclusions two years ago, although no effort was made to embody such results in a formal report.

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A MAN'S value to the company which employs him is usually figured in terms of his wages, that is, his wages are considered as the interest, at the current rate, on the sum he is worth. For example, if a man's wages are $3,000 per year, and money is worth 5 per cent. then his value in dollars and cents is $60,000. The value of an education can be figured on the same basis. If a man is worth $1,000 more per year to a company by having an education, then at 5 per cent. his education is worth $20,000, or he has actually received $5,000 per year for the four years he spent in college. If he is only worth $100 more per year, his education is worth $2,000, which is enough to pay for it. An education certainly pays.

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MANY of the alumni and former students have written, within the past few months, to President O'Harra and other faculty members, words of commendation of the PAHASAPA, and of the school and its work. This evidence of loyalty and good will is appreciated. It seems to us, however, in view of this interest that some effort should be made in the near future to re-organize the Alumni Association. Even if the necessity of earning a livelihood has scattered our graduates to the four corners of the earth, still with a capable secretary, the association should prove to be of distinct benefit to its members and of increasing service to the school.

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THE SOUTH DAKOTA SCHOOL OF MINES takes pride in the success of its graduates. A mere cursory examination of the alumni list published in the annual catalog of the school will show how they have made good in professional life. It is needless to say that it is the expectation of both faculty and student that the present senior class will also do creditable work in their new fields of labor.

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Some of the epigrams printed in this issue were taken from the Sixth Annual Report of the Carnegie Foundation for the Advancement of Teaching.

ANNOUNCEMENTS.

SOUTH DAKOTA STATE SCHOOL OF MINES.

PROGRAM OF COMMENCEMENT WEEK.

Sunday, June 2nd.

10:30 a. m. Baccalaureate Sermon, Rev. J. A. Gallaher of Rapid City. First Presbyterian Church, Seventh and Kansas City Streets.

Tuesday, June 4th.

8:00 p. m. Faculty Reception at the School of Mines. All laboratories, lecture rooms, and museums will be open for inspection.

Wednesday, June 5th.

8:30 p. m. Commencement Exercises. Address by Hon. Norman T. Mason of Deadwood. Conferring of degrees. Derthick's Opera House, Kansas City Street near Fifth.

✣

FIELD WORK IN SURVEYING.

The summer field work in surveying will begin this year on Monday June 3 and last until June 22. The tract selected for this year's work in topographic surveying extends, roughly, from the south side of Smelter Hill to the Northwestern Railroad's coal elevator, and from Rapid Creek on the east to Ivy Avenue on the west, thus including the School of Mines campus. This tract is not so rough as that worked over last year, but it has a greater area and will include a greater variety of topographic forms. The mining work will be done this year in the Standby Mine again, at Rochford, and will occupy the last week of the period given above.

✣

RHODES SCHOLARSHIPS.

The next qualifying examination for the Rhodes Scholarships will be held at the University of South Dakota on Tuesday and Wednesday, October 15 and 16. For particulars address the undersigned.

FRANKLIN B. GAULT,
Chairman of the South Dakota Committee of Award, Vermillion, S. D.

May 11, 1912.

BLACK HILL'S GOLD AND SILVER PRODUCTION.

	Gold	Silver	Total
1875	$ 10,000	$.........	$ 10,000
1876	1,400,000	....	1,400,000
1877	2,000,000	....	2,000,000
1878	3,000,000	....	3,000,000
1879	3,600,000	10,000	3,610,000
1880	4,200,000	71,000	4,271,000
1881	4,000,000	70,000	4,070,000
1882	3,300,000	175,000	3,475,000
1883	3,200,000	150,000	3,350,000
1884	3,300,000	150,000	3,450,000
1885	3,200,000	100,000	3,300,000
1886	2,700,000	425,000	3,125,000
1887	2,400,000	540,000	2,940,000
1888	2,600,000	100,000	2,700,000
1889	2,900,000	135,331	3,035,331
1890	3,200,000	129,292	3,329,292
1891	3,550,000	129,293	3,679,293
1892	3,700,000	75,119	3,775,119
1893	4,006,400	181,527	4,187,927
1894	3,299,100	37,153	3,336,253
1895	3,869,500	45,858	3,915,358
1896	4,919,000	301,950	5,220,950
1897	5,300,000	298,950	5,598,950
1898	5,720,000	189,345	5,909,345
1899	5,848,000	208,530	6,056,530
1900	6,625,000	128,961	6,753,961
1901	6,497,500	45,981	6,525,481
1902	6,965,400	177,344	7,142,744
1903	6,826,700	119,448	6,946,148
1904	7,024,600	108,460	7,133,060
1905	6,913,900	108,030	7,021,930
1906	6,604,900	105,196	6,710,096
1907	4,138,200	70,400	4,208,600
1908	7,742,200	104,301	7,846,501
1909	6,573,600	101,098	6,674,698
1910	5,380,200	60,685	5,440,885
1911	7,430,367	206,188	7,636,555
	$163,926,567	$4,859,440	$168,786,007

OUR EXECUTIVES.

M. F. COOLBAUGH.

Since the establishment of the South Dakota State School of Mines in 1885, a number of men who later became quite noted in science have been connected with it for short periods of time. Among those who held the office of Dean, as the head of the school was called in the early days, the best known were the following: Franklin R. Carpenter, who later became one of the foremost mining men of the West; W. P. Headden, at present Professor of Chemistry in the Colorado Agricultural College; Dr. W. P. Jenney, now a consulting geologist in Washington, D. C.; and Dr. V. T. McGillicuddy, one of the pioneers of Rapid City, who now resides in California.

The modern history of the institution may be said to have been begun with the appointment of Robert L. Slagle to the presidency in July, 1899. Dr. Slagle was graduated with the degree of A. B. from LaFayette in 1887, received his master's degree from the same college in 1890, and the degree of Ph. D. from John Hopkins University in 1894. He came to the School of Mines as Professor of Chemistry in 1897, and was president from the summer of 1899 until January 1906 when he became president of the South Dakota State College at Brookings. Under his administration the school made a remarkable growth, and gained a standing for efficiency that it had never held before.

Dr. Slagle was succeeded in the presidency by Charles H. Fulton. Dr. Fulton was graduated from Columbia University with the degree of E. M. in 1897. After some practical field work he came to the South Dakota School of Mines in 1900 as head of the department of Metallurgy. While president he wrote A Manual of Fire Assaying and Principles of Metallurgy. He received the Doctor's degree from the South Dakota State University in 1911. Dr. Fulton's management emphasized the technical training and he strengthened and built up the several departments of the school, and so provided it with equipment that it stands as the equal in efficiency of any school of its kind in the country. He left South Dakota in 1911 to become head of the department of Mining and Metallurgy in the Case School of Applied Science in Cleveland, Ohio.

President Fulton was succeeded by Cleophas C. O'Harra. Dr. O'Harra took his Bachelor's degree from Carthage College, Ill., in 1891 and his Ph. D. from John Hopkins University in 1898. He

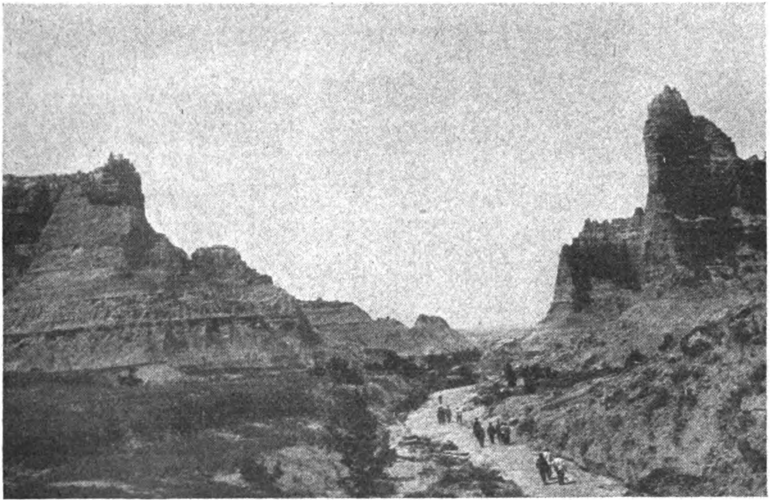
President C. C. O'Harra.

became Professor of Mineralogy and Geology in the South Dakota State School of Mines in 1898 and president of the institution in July, 1911. Since his connection with the school he has won an enviable reputation as a geologist and has published several bulletins which rank as authority on the distinctive geology of the Black Hills region. Dr. O'Harra is a true man of science and his year as executive has shown that he is admirably fitted to preserve the best traditions of the school and guide its further development.

THE BADLANDS TRIP OF 1912.

R. P. JOHNSON.

The term Badlands is applied to a very rough and rugged country found especialy in Wyoming, Montana, Nebraska, North Dakota and South Dakota. Of these, the South Dakota Badlands are of the greatest interest, because of their extreme roughness and complexity, and also because of the abundant fossil remains which they contain.



Geology Class in the Badlands.

The Badlands are formed chiefly of very fine clay or shale interspersed with strata of conglomerate and coarse sandstone. These different strata were deposited nearly horrizontally and have suffered no great change since. It has long been an open question as to what the conditions were at the time of deposition. At first, geologists supposed the materials to have been lake deposits. It is now believed that they were deposited by sluggish rivers meandering across great mash flood-plains.

Arriving at Interior a little before noon, we secured a team and were driven to the foot of Big Foot Pass. This pass gets its name from an Indian who escaped from the whites through it. Climbing to the top of the great wall a fine panorama of hills and gulches was spread out below us. The most striking thing here was the banding;

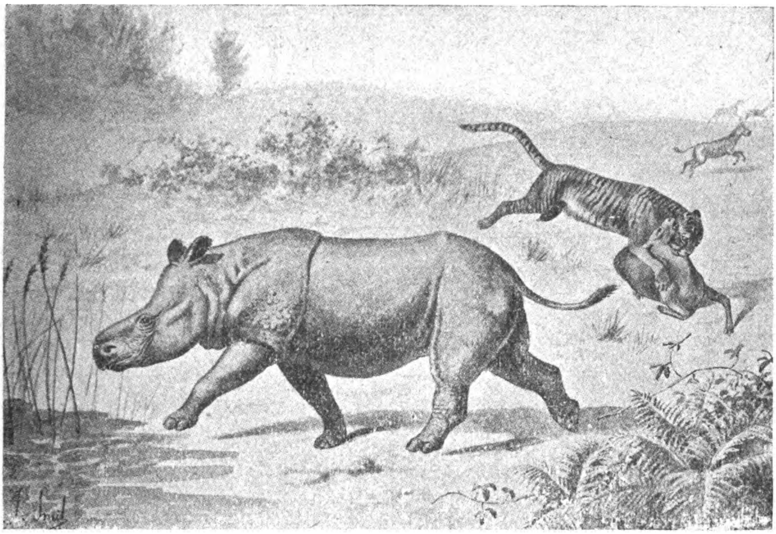
reds, yellows and greys, some thick and some thin, but all arranged in the same order on each hill. To the north stretched a rolling prairie, green with grass except where a homesteader was busily putting in a crop.

After President O'Harra had pointed out some things of especial interest we started, in an easterly direction, for some high peaks.

A Thirsty Student in the Badlands.

Part of the road was on grassy sod and part across areas that had been washed and cut by water and were very rough. Walking on east we came to beds that contained fossils. Everyone immediately began following draws and wash-outs in the hope of finding something interesting. Teeth were about the only remains that were worth picking up, as the bones nearly always crumbled under the touch. Some were fortunate enough to find teeth of three-toed horses, extinct species of giant pigs, rhinoceroses and other vertebrates. Later in the afternoon a well preserved head of an Oreodon was found; and the next day President O'Harra found a fine specimen of a carnivore. Soon we struck the trail through Saddle Pass, which is as its name implies only passible for saddle horses. From the pass it was only about three miles to town, and we soon arrived there hungry, tired and some of us a little foot-sore.

Early the next morning we walked northeast to Cedar Pass. This pass gets its name from the small cedar trees that grow in the draws around it. Many of the formations here were practically the same as those seen on the previous day, but some were higher stratigraphically, so the fossils were a little different. Several small, natural bridges were found. Many of the class secured good pictures of them. The top of the wall was much rougher, many points, protected from erosion by caps of sandstone, stood up perpendicularly several hundred feet above the surrounding country.



Restoration of some South Dakota Badland Animals.

The Badlands are located in a semi-arid country. Here the rainfall is light, long periods of drought are interspersed with short hard showers The soft clays are cut away rapidly, leaving the hard sandstone jutting out in perpendicular cliffs: Thus deep, narrow ravines are formed, giving the rugged appearance to the country.

As the Badlands hold so much of interest and importance to geologists, it has been the custom for the geology class to spend a few days each year in them. Before the railroad was built through them it was necessary to make the trip overland, a distance of fifty or sixty miles from Rapid City. Now it is possible to go by rail, and thus save the long tedious drive. Two points of especial interest are easy of access. These are Sheep Mountain, a few miles from Scenic and the Great Wall, north of Interior.

This year the class went to Interior. While still many miles away, President O'Harra began to point out small isolated patches of Badlands formations. Going through Scenic we were able to see Sheep Mountain Table, to the south, and soon afterwards to the north the first low bluffs of the Great Wall, extending for miles almost parallel to the track.

Toward noon as the wind began to raise and it looked like rain we hurried on westward till we again came to Saddle Pass. We reached Interior in time for dinner, gathered our fossils and canteens together and took the train for home. All were tired, but everyone voted that the trip had been a fine one, and that much had been learned about the Badlands.

An Interesting Group.

THE LATEST IN FLOTATION LITERATURE.

THE latest flotation literature describes another "greater copper ledge on earth," found in Yavopai county, Arizona, by a "mining engineer and magazine writer" of Sycamore, Kansas, who visited the property "to collect data concerning copper and the company's great ledge." From what the Kansas "expert" wrote we gather that he went out into the sycamore grove and lighted his pipe, whence arose a great smoke. Part of his dream is imparted to stockholders in the following verbiage: "Copper—a red, ductile tenacious, malleable metal of great and varied use, originally called brass of cypress; copper sand, alacanite, C group of minerals, mostly soft, included C cuprite, malaconite, malachite, malconite, chessylite, chrycopyrite, olionite, etc. Black C ore, malaconite, gray C ore, chalcocite, C purite, yellow C ore, variety chalcopyrite, the common ore . . . The formation of the . . . Copper Co. have blended with iron, lime and porphyry with quartz. Many of the above minerals, but more especially the commoner forms with oxides condensed formation on the top with the iron and lime, with a great amount of carbon and sulphur in the scist formation, with an amalgamated condition of the various mineralizations where gold and silver predominate. The schist formation being soft it stands to reason that when the sulphurides appear in the lower rocks, I am led to believe from the geological lay of the uplift that is now held and owned by the ——— Copper Co. there is beneath the surface of this great iron-capped ledge a great body of copper ore." We are unable to follow the Kansas wizard into the new mineralogy, but it must be impressive to the unsuspecting stockholders.—*Engineering and Mining Journal.*

THE largest railroad station in Germany has just been completed at Leipzig, costing $34,000,000. The new building has been in course of construction for the last nine years. The structure is of enormous size and has almost unlimited space for the accommodation of freight and passenger service.

* * *

The time is near when some measurable results ought to be presented from the introduction into theological schools of courses on the economic, psychological, and sociological aspects of religion.

NOTES FROM SCIENCE AND INDUSTRY.

The following notes were taken from an address delivered before the American Electrochemical Society by Dr. Leo H. Brekland:

All great feats recorded in the history of our race sink to nothingness if compared to what human activity is accomplishing every day since ignorant, arrogant, emotional, spasmodic efforts are slowly but surely giving place to methodical and persistent work based on exact scientific knowledge.

. . . .

Our race will improve as long as we put more pride in raising better children than in finding an excuse for our littleness or a consolation for our failures, by bragging about the supposed importance of our ancestors.

. . . .

The two most powerful men of our generation are the scientist and the engineer.

Society at large is far from realizing this fact, simply for the reason that the scientist and the engineer manifest their power not as despots, not as cruel tyrants. Their might is not put in evidence by the amount of chattel-slaves they hold in bondage, nor by the barbaric splendor of their lives; it is not marked by the devastation wrought by armies; their work does not consist in conquering and subjugating weaker nations: we do not see them, glorified in painting and sculpture; we do not hear their exploits extolled in song and rhyme; no artists have had to record their triumphant homecoming, greeted as saviors and heroes while marching over the mutilated corpses of their fallen enemies; they do not use their power to sow sorrow, death and misery, or to steal and plunder or fill the museums of a city like Paris with treasures of art taken by force from weaker nations. No, the masses are unaware of the immense power of the scientist and the engineer because both of them modestly play the role of "the servant in the house;" their unassuming life is devoted not to slaughter, destruction or coercion, but to the service of mankind. They do not build useless pyramids cemented with the sweat and blood of overabundant slaves, monuments to vain glorious despots, witnesses to the small value which was put in ancient times on human life and on human labor.

But the modern engineer, applying the principles of science, raises buildings far superior in size and conception than any architecture of bygone ages can boast of; edifices incomparably more comfortable, more hygienic, more appropriate than anything built before. He raises those gigantic structures in as many days as it took years to build a temple.

. . . .

The modern engineer and the scientist realize that much more enduring monuments than stone, brick or bronze will mark the work of this period; they know that the diffusion and application of exact knowledge is shaping the destiny of future generations and will afford more lasting evidence of their efforts than temples or statues; they believe that their work will not count merely for material betterment, but that improved material opportunities created by them will bring forth better people, higher ideals, a better society.

To put it tersely, I dare say that the last hundred years under the influence of the modern engineer and the scientist have done more for the betterment of the race than all the art, all the civilizing efforts, all the so-called classical literature, of past ages, for which some respectable people want us to have such an exaggerated reverence.

. . . .

Few men stop to compare the conditions of modern life with those of the good olden times. An average man who thinks himself underpaid and imagines he is living at a very modest pace, does not realize that when he is traveling in a modern railroad train he enjoys comforts and advantages never dreamt of by the richest or most powerful men, princes or kings, of scarcely a century ago; he forgets that his life is surer, that his health is better taken care of, than that of any potentate of former times; that the nation respects more permanently his rights as a citizen, than was the case of prime ministers of one or two hundred years ago; that his sons and daughters have better and surer opportunities of education and intellectual advancement, than the children of kings of past centuries; that there is no beautiful thought in this world, no knowledge, which is not acessible to him and everbody who can read.

. . . .

In the development of some of our industries, nothing has played such an important role as scientific research work. To those who do not realize this, let me tell that not so long ago I had an opportunity in Philadelphia, to see that old electric machine of Benjamin Franklin, a small revolving glass globe mounted on a wooden frame; this was about as far as electricity went a century ago. Shortly afterwards, I was confronted by those gigantic electric installations at Niagara Falls. To those who belittle the value of scientific research, I recommend a comparison between this and Franklin's machine, a mere scientific toy, a clumsy affair, that would at its best performance, and if the weather was not too damp, give off some small sparks; a contrivance so useless in its time and so devoid of apparent practical applications, that if some one had told to a "shrewd business man" of last century, what this field kept in store for us, he would merely have shrugged his shoulders in derision. But now behold the hundreds of thousands of electrical horsepower developed in those monstrous generators of Niagara Falls, sensitive as a slender nerve, and yet running with the precision of a watch; distributing power and light to distant cities like Toronto and Syracuse; running heavy railroad trains as surely as the tiny drill of the dentist; converting ores into metals; transforming hundreds of tons of brine daily into caustic soda and bleach; changing mixtures of sand and coal into carborundum; ennobling plain coal into graphite, or producing from coal and limestone new sources for illumination under the form of cacium carbide; or again fixing the nitrogen of the air on calcium carbide to change it into cyanamide, a most valuable synthetic fertilizer ;and at every succeeding year, new chemical achievements of this kind are still being brought forward by a set of tireless workers.

Let me ask a fair question of those who underestimate the value of research: Has that stupendous gap between Franklin's toy and the power companies of Niagara Falls been bridged by anything but by scientific research of the highest order?

CARNEGIE FOUNDATION PENSION SYSTEM.

The specific things that the system of retiring allowances maintained by the Foundation offered to the college teacher are three in number: (1) A fair retiring allowance after sixty-five years of age; (2) a disability allowance after twenty-five years of service as a professor, in case of a failure in health so complete as to unfit him for his work as a teacher; (3) the payment to the widow of a professor who has had twenty-five years of service, of a pension equal to one-half of the allowance he would have been entitled to at sixty-five.

ATHLETICS OF 1911-1912.

BASEBALL

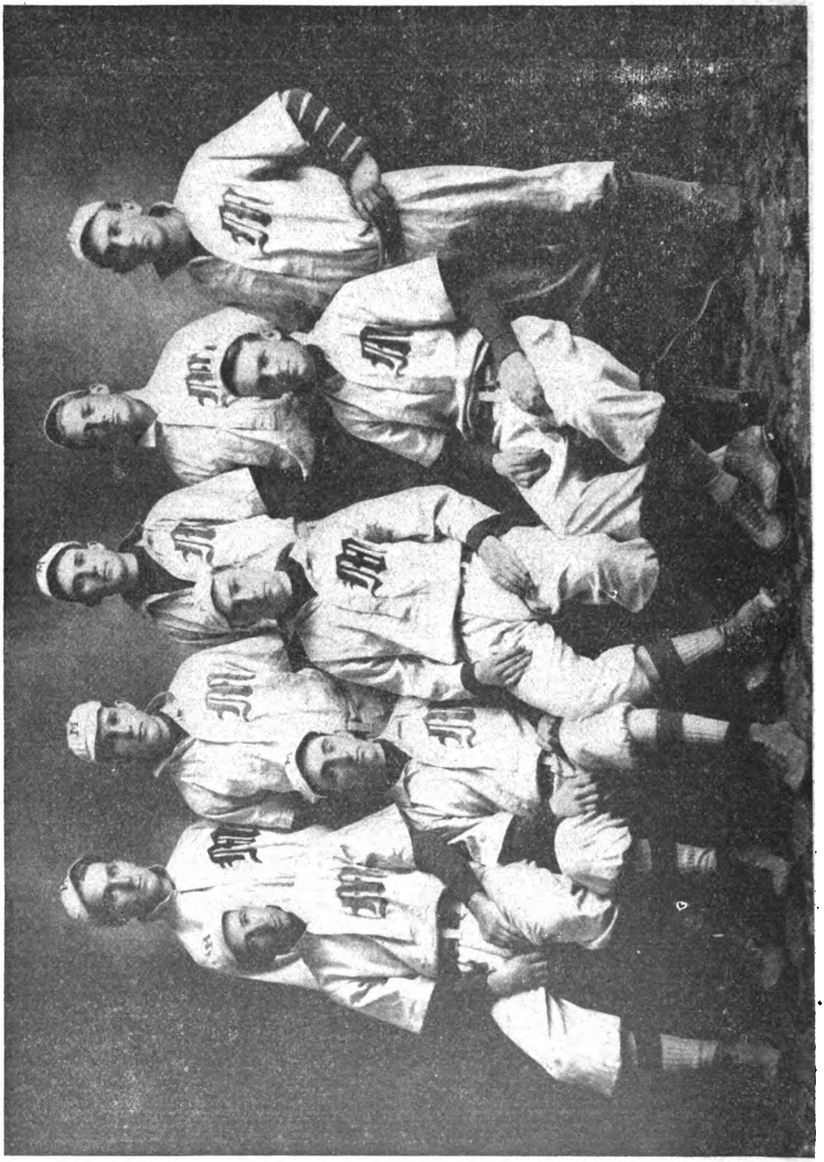
The School of Mines has had one of the best baseball teams this year in the history of the school. Handicapped at first by lack of practice due to poor spring weather the team made very little progress in the early season practice games. It was only after the splendid showing at Spearfish that the team seemed to round into a semblance of form. This was quite apparent on the eastern trip, for every team played gave the School of Mines credit for playing fast and snappy ball. Indeed, the showing of the team on that trip was surprisingly good; and while the majority of the games were lost the margin between victory and defeat was very narrow. If the playing season were not so short, undoubtedly the School of Mines baseball team of 1912 would easily lead all the teams of the state. An account of the games played and their scores follows:

SPEARFISH NORMAL.

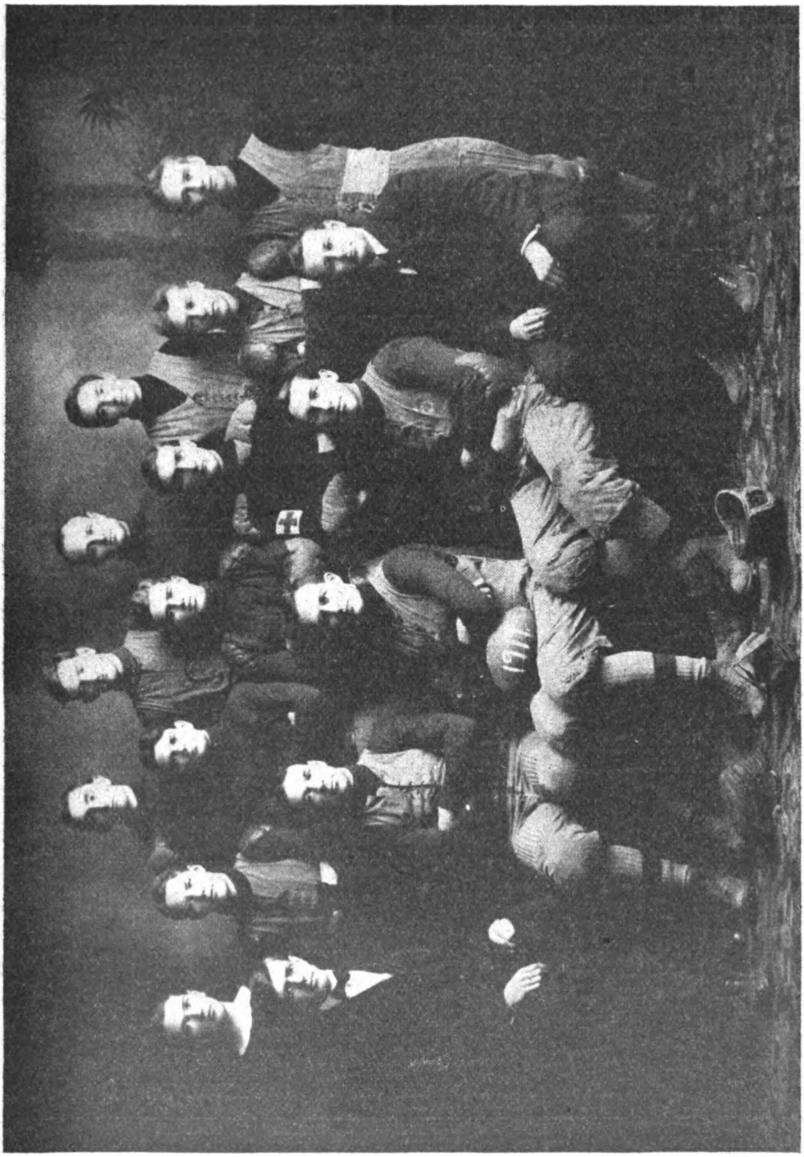
On May 6 the Miners played the State Normal at Spearfish. The cold day and a heavy diamond combined to make a fast game impossible. Wright pitched his first game for the Miners and Humbert, for the Normal. The first part of the game was close. In the fifth inning the Miners began hitting and scored 8 runs. The Miners continued hitting throughout the remainder of the game. The final score was 18-4 in favor of the Miners. The game was fairly well played, it being the first game of the season. A dance was given in the evening in honor of the Miners and afforded pleasure to everyone.

SPEARFISH TOWN TEAM.

On May 7, the Miners played one of the hardest games of the season. The opposing team was the Queen City Athletics of Spearfish. This team was known to be composed of veteran ball players, and the Miners were ready to play their best. The Miners won the game in the second inning, scoring all four of their runs in this inning. Spearfish played a good game after the second inning, and made the Miners play ball all the time. Fahrenwald pitched good ball for the Miners, securing eleven strikeouts and allowing four hits. Billington for Spearfish was replaced by Guerner after the second inning. Guerner pitched good ball and kept the hits scattered. The final score was 4-3. In this game the Miners showed a marked improvement over their playing in any previous game.



Baseball Team of 1911-12.



Football Team of 1911-12.

STATE COLLEGE.

The team left for Brookings on Friday night, May 10, to play the State College on Saturday. The players rode all night and consequently were not in their best condition in this game. The Miners started strong and scored two runs in the first inning. Brookings scored one run in their half. The score remained stationary until the sixth inning when Brookings scored one, making the score a tie 2-2. In the seventh Brookings scored 4 runs on a hit, a base on balls and a couple of exceedingly rank decisions by the umpire. The umpire officiated entirely from behind the catcher, this probably accounted for some of his questionable decisions on bases. The Miners came to bat in the ninth with the score 6-2 against them, and by a series of hits scored 4 runs tieing the score. In the eleventh Brookings succeeded in getting three men on bases and no one out. The Miners again tightened and put the side out with no scores. In the twelfth Brookings scored the winning run on a base on balls and a hit after two were out. Fahrenwald was in good form but was handicapped by the wind. Korner allowed 5 hits and struck out 6 men. Fahrenwald allowed 7 hits and secured 11 strikeouts. The game was hard fought throughout and should have been the Miner's game.

MITCHELL.

The team arrived in Mitchell from Brookings Sunday morning and after the day's rest were in fine shape for the game with the Dakota Wesleyan on Monday. The day was clear and warm, making it a very favorable day to play. Again the Miners started strong, scoring one in the first inning. Mitchell saw her danger and tied the score in the last half of the first inning. The Miners scored one in the second on two hits and secured another run in the fourth. Mitchell also scored one in the fourth making the score 3-2 in favor of the Miners. During the next four innings both teams played good ball and no scores were allowed by either side. In the ninth the Miners scored one and the ministers followed with one for themselves, making the final score 4-3 in favor of the Miners. The game was well played throughout, each side making three errors. Wright pitched good ball, allowing seven hits and getting seven strikeouts. Smith allowed eight hits and struck out two Miners.

YANKTON

At Yankton on May 14, the Miners played another good game, although the score was against them after ten fast innings. Again the Miners started early, scoring one in the first inning and two more in the second. Yankton scored one in both the second and third innings and the Miners scored another in their half of the third. Yankton tied the score in the seventh on a hit and an error. Neither team was able to score until the last half of the tenth when Yankton scored the winning run. The Miners hit the ball hard all through the game, but owing to the wind, were not able to hit safe.. Brilliant work by Yankton's outfield saved the game for Yankton several times. Boland pitched great ball, allowing five hits and getting eight strikeouts. Reman, for Yankton, was the best pitcher encountered by the Miners up to this game. The Miners secured but two hits and he struck out eight men.

STATE UNIVERSITY

Remembering their experience of last year the Miners went into this game determined at least to hold the University to a close score.

The game was a pitchers' battle between Riter and Fahrenwald, neither had any advantage. In the first inning the University looked formidable, scoring one on a base on balls and a hit, but after that the Miners were not worried at any time. The Miners were unable to hit Riter safe. In the ninth inning the Miners succeeded in getting two men on bases, but were unable to score. The final score was 2-0 in favor the the University.

Fahrenwald pitched excellent ball, allowing but two hits and securing nine strikeouts. Riter allowed no hits and struck out twelve Miners.

The Baseball Twins.

FOOTBALL

The 1911 football season demonstrated that the School of Mines had an abundance of good football material. Under the leadership of Captain R. S. Hill and the assistance of a good coach, the 1912 team should prove to be a winner.

Manager A. Anderson has been busy arranging a good schedule of games. State College and the Colorado School of Mines have agreed to accept dates and the South Dakota University and Yankton College have written for terms. Long before the school opens in the fall, all arrangements for games will be completed. The schedule which follows is only tentative and is subject to change:

Oct. 19—South Dakota State College at Rapid City.
Oct. 26—Huron College at Rapid City.
Nov. 2—Open.
Nov. 9—University of Wyoming at Cheyenne, Wyo.
Nov. 16—Open.
Nov. 21—Dakota Wesleyan University at Mitchell, S. D.
Nov. 23—Open.
Nov. 28—(Thanksgiving Day) Colorado School of Mines at Rapid City.

Playing the Game.

VOLATILE MATTER.

Smith and Jones were speaking about the fine points of their respective sons.

"That boy of mine," remarked Smith extravagantly, "is the genuine article! He's all wool, you can bet!"

"Shouldn't wonder," commented Jones. "I notice he shrinks from washing."—*Tit Bits*.

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"What dirty hands you have, Johnnie!" said the teacher. "What would you say if I came to school that way?"

"I wouldn't say nothin'," replied Johnnie. "I'd be too polite."—*Delineator*.

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He who takes the bonnie lass upon his sturdy knee,
Will never integrate the Calc out to infinity.
To be a mathematician from fussing you must be free
And never whisper pleas of love to your affinity.

—o—

Dr. Marcus Herz, of Berlin, is credited with saying to a patient who read medical books diligently in order to prescribe for himself: "Be careful, my friend. Some fine day you'll die of a misprint."—*Current Literature*.

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The physiology class in a country school was studying about the backbone.

Teacher—"What are the pieces of cartilage for between the vertebrae?"

A little boy raised his hand.

"Well, Eddie, you may tell us," the teacher said.

"To take the jars off the jumps," answered the triumphant Eddie.—*Ex*. . . . .

In the exchange department of a big Broadway store a pretty creature, a bride, evidently, approached the manager and said:

"Do you exchange wedding presents?"

"Certainly, madam, if they were bought here," he replied.

"Then," she said, blushing a little, "I'd like you, please, to take back a set of Russia leather automobile trunks. I'll take the amount out in canned goods from your delicatessen counter.—*New York Press.*

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Poet—"I called to see if you had an opening for me."

Editor—"Yes, there's one right behind you; shut it as you go out, please."—*Satire.*

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As a result of the expansion due to heat the Singer Building is about three-fourths of an inch higher in summer than in winter. Therefore," says Prof. Ziegler, "to see it at its best go in July."

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Prof. Coolbaugh has made the startling discovery that molybdenum will not reduce below the green on St. Patrick's Day.

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Prof. German announces that he has discovered a method by which three apples can be divided equally among seven people.

"How does he do it?"

"Makes apple sauce of them."

Perhaps the professor can tell us why the hen................

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Gink—"Your son is pursuing his studies at college, isn't he?"

Dink—"I guess so. He's always behind."—*Judge.*

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A New Field.—A suffragette umpired a game of baseball in California the other day. Thus the last sacred precinct of man's work has been invaded.—*Detroit Free Press.*

ALUMNI NOTES AND LOCALS.

ALUMNI NOTES.

Areli C. Overpeck '02 was a welcome visitor at the school a few days ago.

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B. V. Matson '07, one of the successful applicants for a government position, is assayer in the U. S. Assay Office in Deadwood.

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Jesse O. Betterton, '09, as assistant chemist, American Smelting & Refining Co., Omaha, Nebr., is doing considerable research work for the company.

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J. W. Hancher, the first graduate of the School of Mines, has recently written from both Chicago and San Francisco concerning his interest in the school and its work.

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P. R. Whytock '06, former editor of the Aurum and a man of great versatility, both in and out of his profession, is superintendent of a mill of the National Mines Co., National, Nev.

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E. Van L. Smith '06 after several years of continuous and successful service with mining companies has been compelled to quit active work on account of ill health. He is now at his home in Akron, Ohio.

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Glen P. Ives '08 is practising his profession of mining engineer at Santiago, Chile, and is quite prosperous. He says, "Quite frequently I have the pleasure of meeting my two classmates, I. D. Ossa and D. C. Woodward, with whom the conversation always goes back to the days at the School of Mines."

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U. S. S. Arentz '04, General Superintendent Nevada Douglas Copper Co., and Nevada Copper Belt R. R., Ludwig, Nev., mentions in a recent letter that E. W. West '04 is checker at their smelter and E. D. Trenam, at one time manager of the Aurum and also manager of the S. of M. football team, is in charge of the stock.

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Prof. C. H. Fulton and Z. Jeffries '10 of the faculty of the Case School of Applied Science will take the Junior class of that institution to Ducktown, Tenn, and Burmingham, Alabama, for a part of the summer. The students will study coal mining. Prof. J. Burns Read '06, also connected with the same school, will take the Sophomores to Greensburg, Pa., for a similar study.

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J. H. Saville '10 and C. Willard '11 visited the school a few days ago and renewed acquaintance with some of the students and members bers of the faculty. Among the former students, who have visited the school recently, may be mentioned Ole Nelson of Salmon, Idaho, and Judge A. P. Schnell of Sturgis. Judge Schnell found considerable pleasure in meeting Prof. H. L. McLaury, who is the dean of the faculty in point of service and the one to whom the graduates and students of former days naturally gravitate.

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Cyril Cooledge '08 writes from San Juancito, Honduras, "From graduation I was with the Bishop Creek Gold Co., for a year and a half as assayer and engineer. and gave satisfaction. When the works were closed down, I was sent to British Guiana for the same company and in the same capacity. I staid for six months and left after giving two months notice. Upon my return to the States I worked with Mr. Hartgering for a few months and then came down here as assistant engineer. I have been here sixteen months."

LOCALS

Professor V. Ziegler's article on "The Siliceous Oolites of Central Pennsylvania" will be published in the current number of the *American Journal of Science.*

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Announcement has just been received of the death of Mr. C. Trygstad's father. The students and faculty express their sympathy for Mr. Trygstad in his bereavement.

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G. V. Sager lectured to the Economics class, Tuesday, May 21. His subject was, "What I Know about Socialism." Mr. Sager is an instructive and interesting speaker.

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Arrangements are being made to enlarge the mining and metallurgical museum room. This, with the placing of new cases, will become one of the most attractive features of the school.

Miss Frances Hartgering, who was a special student last year, is now a sophomore at the State College, Brookings. She is one of the staff of the Collegian, a weekly publication of that school .

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The college classes have elected the following student representatives for membership in the Board of Cintrol of the Athletic Association: Freshmen, O. H. Borst; Sophomores, R. S. Hill; Juniors, Alfred Alder, Jr.

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The student body is well supplied with cameras. Most of the students possess one, and the collection of views secured by them is certainly interesting. J. H. Johnson has succeeded thus far in doing the best photographic work.

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May 4 was a general moving day for several of the professors. Prof. Ziegler moved into the house just vacated by Prof. Ehle, who will be in California during the summer vacation. Prof. Steele moved into his new house on East Kansas City Street.

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During the summer there will be installed in the power house, a couple of new marine type boilers and one electric generator, at a cost approximating $4,500. In addition to these improvements, $5,000 will be expended in repairing the preparatory building.

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The Anaconda Mining Comany a few weeks ago furnished the school with 500 pounds of copper ore; of this 200 pounds are of a high grade, the rest being the regular concentrating ore. The Seniors are using the material for the purpose of thesis investigation.

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R. H. Drake and W. Boland left school a few days before examination week. Mr. Drake has filed on a claim in Perkins county, and will make ranching his main business. Ex-captain Boland of baseball fame will assist his father at Wind Cave, Hot Springs, S. D.

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Since the warm weather has come and the balmy days of spring are here, everyone seems to have the well known disease called "spring fever." This is especially noticeable in "Math" classes. "Math" problems and "spring fever" don't go well together.

President and Mrs. C. C. O'Harra have been giving a series of dinners and social functions to the student body. They will entertain the Seniors and Juniors a few days before commencement. The students are grateful to President and Mrs. O'Harra for these social gatherings.

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I. J. Hlebnikoff is a pedestrian of no mean ability. Within the past few weeks he has walked to Harney Peak, Keystone, Hill City, Bear Butte, Sturgis, and Scenic. Altogether he has covered several hundred miles. The greatest distance which he made in one trip was 62 miles.

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H. W. Gray, substitute mail carrier in Rapid City, registered a few weeks ago tor special work in Biology. Mr. Gray attended Morningside College and Nebraska Wesleyan University before coming here, and is planning to take a course in medicine sometime in the near future.

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Several of the geology class while in the Badlands wandered away from the rest of the students. In the course of their wanderings they started down one of the numerous gulches of that region. To their surprise and astonishment they stumbled upon a bottle containing a note left by the class of 1910. It was signed by Messrs. Taylor and Stanley, former students of the school.

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The mining and metallurgical museum has been enriched lately by a complete No. 7 water lined rock drill, three display cases from Du Pont Powder Co., containing exhibits of their various commodities, and a complete line of refactory materials, furnished by the following companies: Harkbison & Walker Refactories Co., Dixon Crucible Co., Norton & Alundum Co., National Carbon Co., Carborundum Co., of Niagara Falls, and the Denver Fire Clay Co.

—o—

The school has been favored recently with two lectures of considerable interest. Both of these were delivered under the auspices of the Economics class. The first address, which was on "Single Tax," was given by Hon. Judge Levi McGee. The Judge who is an enthusiastic speaker gave a very able and comprehensive presentation of his subject." The second address, which dealt with "Trust Company Methods, was also ably handled. The speaker, Attorney

G. Miser, a rising young attorney, gave some first hand information concerning Trust Companies.

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A great many persons have taken advantage of President O'Harra's invitation to visit the School of Mines. There is scarcely a day that does not bring its quota of visitors. On May 15 the delegates to the District Development Association visited the School and expressed themselves as well pleased with its equipment. They seemed most interested in the geological museum and the metallurgical and physical laboratories. In the latter laboratory, upon the urgent request of the visitors, wireless telegraph operator Bochert gave a demonstration of the workings of wireless telegraphy.

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On Saturday evening, April 27, Professors C. C. Van Nuys and H. L. McLaury entertained on Cowboy Hill their classes in Calculus and Higher Physics. The picnic was to have been held in the afternoon, but a shower caused a postponement until evening. About four o'clock the company consisting of the students and their young lady friends, the staff of the Pahasapa, a guest or two, and the two professors, made their way to Cowboy Hill. As soon as the destination was reached, a fire was built and the refreshments were prepared. Bacon, eggs, "wienies," pickles, salad, doughnuts, oranges, candy, and ice cream comprised the menu. After the luncheon the party gathered around the camp fire and told stories and jokes until the burning logs became embers. Then the entire company strolled back to town.

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The State School of Mines has students from several of our neighboring states, and one at least from far off Russia. Innocent J. Hlebnikoff came to the School of Mines from the eastern part of Asiatic Russia, and his expenses while here are paid in part by the Russian government. His father is a very successful business man of Blagowetchensk, Russia. Innocent J. Hlebnikoff is handicapped by an insufficient knowledge of the English language, but in spite of this he is acquiring some useful knowledge concerning American methods and customs. Previous to coming here he studied in French schools, and at St. Joseph's College, Yokohoma, Japan. He also attended lectures in Columbia University. Since coming to Rapid City Mr. Hlebnikoff has made quite a reputation for himself as a pedestrian, and is deservedly popular with the student body for his genial and kindly disposition.

THE PRESSURE OF A BLOW.

In a discourse delivered at the Royal Institution on January 26, Prof. Bertram Hopkins gave some very striking figures and described some highly interesting phenomena associated with blows produced in various ways. An account of only a few typical cases may be here presented.

Suppose that each of two equal billiard balls has a speed of eight feet per second and that they are moving towards each other along their line of centers. At the very instant of touching there is, of course, no pressure between the balls, but as the centers continue to approach, each sphere becomes flattened at the region of contact. This region is circular and it rapidly increases in area until the balls as wholes are brought to rest, that is, until the work done against the elastic forces of restitution is equal to the original kinetic energy of the system. For the case in question the distance of approach is 14-1000 of an inch and the force equals 1,300 lbs. The circle of contract has a diameter of one-sixth of an inch, so that the average pressure amounts to 27 tons per square inch. The distribution of pressure, however, is not uniform, the pressure at the center of the areas of contact being 1½ times as great as the average pressure. The subsequent behavior of the spheres is of no interest in this connection. If very hard, hollow steel balls, having the same mass as the ivory spheres, are caused to collide with a relative speed of 16 feet per second, the distance of approach will be less, the area of contact smaller, and the maximum pressure much greater than for the billiard balls. This pressure when averaged over the circle of contact attains a value of 280 tons per square inch. These results of theoretical computation for steel balls have been verified by comparing the calculated time of contact with the interval obtained experimentally by the aid of appropriate electrical apparatus. The time of contact for the ivory spheres, mentioned above, was 1-4000 of a second.

A case involving an inelastic substance is afforded by the impact of an elongated lead rifle bullet against a hard steel plate. Under the enormous pressure developed lead flows very freely, so that, in the absence of any lateral support, each cross-sectional disc of the bullet maintains its speed practically unchanged until it comes in direct contact with the steel. The pressure exerted by the bullet is, probably, sensibly constant, since it depends upon the square of the speed, but not upon the length or diameter of the projectile. Increase in diameter only alters the area over which the force is applied, and increase in length the time during which it acts. As a practical example, consider a Lee-Metford bullet moving with the normal speed of 1,800 feet per second. This projectile is 1¼ inches in length, it has a mass of about 0·03 lb., and it would be stopped in 1-18000 of a second. The force required to destroy the 1·7 lb.-second units of momentum would be 15 tons. Since the area of cross-section of the bullet is 1-14 of a square inch, the mean pressure would amount to 210 tons per square inch.

Passing over several interesting cases involving the propagation of longitudinal waves along steel rods, we shall now consider very briefly some entirely new investigations made by Hopkinson on the effects produced by detonating small cylinders of gun-cotton in contact with steel plates. The gun-cotton is converted into gas at small volume, high temperature, and enormous pressure, in roughly three or four millionths of a second. The only thing which restrains the expansion of the gas is the inertia of the surrounding air, and the pressure accordingly drops with very great rapidity. It is estimated that the pressure falls from 120 tons per square inch to atmospheric value in about 1-25000 of a second. The same pressure is, of course, exerted by the gas upon any rigid surface with which the gun-cotton is in contact, and the force so produced has the characteristics of a blow, namely, great intensity and short duration. If a cylinder of gun-cotton weighing one or two ounces is placed in contact with a plate of mild steel one half an inch thick, or less, and if the explosive is then detonated, the effect will be to punch a clean hole through the plate, of approximately the same diameter as that of the cylinder of gun-cotton, just as if a projectile had passed through the plate. On the other hand, if the steel plate had a thickness of three-quarters of an inch, a very curious result would be obtained. A depression would be formed on the side of the plate next to the explosive, while a disc of corresponding diameter would be torn off from the opposite face of the plate and projected with very high speed. The speed, in fact, corresponds to a large fraction of the whole momentum of the blow. By detonating a two-ounce cylinder of gun-cotton in contact with a still thicker plate of steel, a depression and a complementary bulge were produced on the respective faces of the plate. When the plate was sawed in two in a plane containing the centers of the dent and of the lump, the presence of an internal crack was brought to light, thus showing the beginning of that separation which was complete in the case of the plate three-quarters of an inch thick. All of these phenomena can be accounted for by simple mechanical principles involving the reflection of longitudinal or sound waves in the metal.

In conclusion, a few words with regard to the behavior of large projectiles and armor-plate may not be without interest. Modern shells are made of a special steel of great strength and considerable ductility, the region of the point only being subsequently hardened by thermal treatment. When a shell of this construction strikes normally against a plate of wrought iron, or even mild steel, it ploughs straight through the plate, pushes a plug of metal before it, and emerges unscathed. A rim or lip is formed on the incidence face of the plate, which is analogous to the rim arising when a hole is blown in a lead plate by means of a gun-cotton primer. To bring a 14-inch shell, having a speed of 2,000 feet per second, to rest would require at least 2·5 feet of wrought iron. Modern armor plate is made as hard as possible on the outside surface, the back being left tough and ductile. When a shell with a hard point is incident normally on such armor, both the projectile and the plate are seriously damaged, but the former does not penetrate the latter. Even when a thinner plate is pierced by the shell the projectile is usually smashed to pieces in the act. To overcome this lack of penetrating power it has become the custom, in recent years, to provide the point of the shell with a cap of soft steel. In this event the projectile punches a clean hole both in its cap and through the armor plate. In some instances the shell is so nearly intact as to admit of its being used over again. The cap seems to form a ring around the nose of the shell at just the right instant, preventing any lateral deformation or flow of the tip, thus concentrating the blow over a small area and enabling the projectile to pierce the armor.—*Nature.*

Thrift is a fundamental human virtue.

* * *

Hope, not fear, is the great propulsive power in humanity.

* * *

In no field of education, and one might well say in no field of civilized activity, is there today a larger opportunity for the wise use of money than is found in medical education, provided such assistance goes to institutions worthy of such aid.

THE TWENTIETH CENTURY ENGINEER.[1]

The engineer is now more than ever before an essential factor in affairs. Engineering information and technical skill are in demand in many fields not heretofore requiring them. What manner of man is this present-day engineer, whose existence and work are so vital to the higher interests of society? What are the intellectual qualities that fit him for his high office, what the aptitudes that qualify him for leadership, what the supreme test of his fitness to bear on his shoulders some of the burdens of organized civil life and to lead the way toward still higher achievements? Finally, what style of intellectual training is best suited to fit him for the prodigious problems awaiting solution at his hands?

It is not necessary, even in this presence, to refrain from saying that the type of man, whom we are about to survey in his highest ethical and intellectual character, is not an artisan, a motorman, nor even an engine-driver, as useful and honorable as these callings are. Nor is it manual training or manual dexterity or mechanical skill that constitutes his claim to recognition as an invaluable contributor to progress in the twentieth century. He is rather the masterful man who unites oceans and revises the paths of commerce; who levels hills and removes mountains if they chance to be in his way; who changes the course of rivers or sends them through tunnels to generate electric light and power and to convert deserts into fruitful fields.

If modern industry demands combination and the massing of capital, combination requires the services of large-minded engineers as managers. When Cecil Rhodes appealed to the Rothchilds for capital to form the De Beers Diamond Mining Company for the purpose of uniting all the diverse and independent claims of the Kimberley diamond field, he was assured that money would be furnished on condition that they be permitted to place in charge their mining engineer as manager--Mr. Gardner Williams, who hailed from the great state of the Golden Gate. Mr. Williams substituted for the open working of the diamond mines his method of mining by vertical shafts, and horizontal tunnels into the core of the precious "blue ground" filling the volcanic pipes, which have yielded uncut diamonds to the aggregate value of more than $500,000,000.

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[1] An abstract of an address delivered at the dedication of Pasadena Hall of the Throop Polytechnic institute.

When the great gold-bearing reef at Johannesburg, the richest gold mining district in the world, needed a controlling genius to direct the Kaffir mines, it was John Hays Hammond, another American mining engineer, who dictated the engineering and mining policies of the Witwatersrand. Hammond adapted the method of mining the ore and winning the precious metal to the conditions existing in that great outcropping reef, forty miles in length, with the result that a low-grade conglomerate has yielded millions of gold with a fair profit to the shareholders. In large enterprises of this character success or failure turns on the trained intellect, the excutive ability, and the comprehensive grasp of the controlling brain at the head.

If we inquire somewhat more minutely into the qualities that make for leadership in engineering, we shall find that thoroughness, originality and the habit of making all mental acquirements one's own are essential. Originality is a gift, but it may be cultivated; the two other qualities are certainly within the reach of every young man with normal mental endowments. The habit of going to the bottom of every subject investigated instead of contentment with a superficial examination is one to be assiduously cultivated. Each essay in concentrated effort makes mental fitness for still deeper levels of penetration.

Thoroughness is associated with sincerity in the conduct of public works. The greater undertaking which an engineer is called on to design and execute are not the ephemeral structures, made of "taff" and designed to house an international exhibition; they are for posterity as well as for his contemporaries. Noble examples of thorough and sincere work have come down to us from ancient times. One allows the eye to follow with admiration the long lines of aqueduct stretching across the Roman Campagna, in large part still standing, though gnawed for centuries by the tooth of time. In the Forum in Rome is an opening into which one may descend to the uncovered Cloaca Maxima, or great drain of the imperial city. It was built long before the Christian era and was old when Paul suffered imprisonment in Rome and execution outside the gates. Huge rectangular blocks of tufa lie in perfectly level courses without cement, and through this great drain today runs a stream, like a small river, on its way to the yellow Tiber. This was honest work and the twentieth century engineer might well imitate it.

Then the proper assimilation of one's information is no less essential than thoroughness. It is not uncommon to observe a sort of aloofness of a man's mental attainments with respect to his powers of practical achievement. He appears to have put his acquisitions in a safety vault and lost the key. His intellectual equipment is for adornment and not for use.

The recent trend of affairs has shown too pronounced a tendency toward undue specialization in engineering practise. It is not enough that instead of the two traditional divisions of engineers in olden times, the civil and the military, there are now in practise civil, mechanical, mining, hydraulic, electrical, telegraph, telephone, sanitary, chemical, electrochemical and illuminating engineers, but the enthusiasts in these several lines are insisting that their specialties be assigned a seat in the circle of the engineering curriculum. This granted, the young collegian has either a narrow training that reduces him to the grade of an artisan, or the instruction given him is so superficial that it never strikes root and never reaches down to stir his subconscious powers. It may be sufficient for the practised eye of a Paulhan to get a vivid impression of the salient features of a landscape from the window of a railway carriage to serve as a guide in an aerial flight over the same region; but the young engineer, who gets a flitting view of the whole field of current engineering practise from the moving-picture show of a lecture-room lantern screen will have only a sorry preparation for sustained flight when he attempts to rise by the power of his own enginery.

If present courses in engineering are to conform to these suggestions, some modifications in the purely technical subjects are requisite. Instruction in these may well be confined more closely to fundamental principles and to the enforcement of them by the concrete examples furnished by the exercises in the laboratory. A multitude of details do not belong in the instruction given to immature students, but to the actual work of the practising engineer. If inquiry is made of the experienced engineer from whom he got the most help in his college course, he will not mention the teacher whose instruction consisted largely of a category of details of the engineering art, but rather the one who marshaled the leading facts of the subject under general principles, brought out clearly the correlation between them, and enforced them by the work of the laboratory, which had obvious and vital connection with the instruction of the class-room.

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United States Bonds	$199,114.00	
Other Bonds to Secure U. S. Deposits	69,950.00	
Cash on Hand	124,676.70	
Due from Banks and U S. Treasurer	432,044.26	825,784.96

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Capital	$ 150,000.00
Surplus	30,000.00
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